Edited at the
Massachusetts Institute of Technology
January, 1970. Price, $1.25

Thomas K. Sherwood: Must We Breathe Sulfur Oxides?
James A. Fay: Oil Spills: The Need for Law and Science
Philip H. Abelson: A Challenge for the Seventies

Technology Review

SO_2

technology
review
Published by MIT

looking for meeting space?

Management Center of Cambridge offers unique meeting services

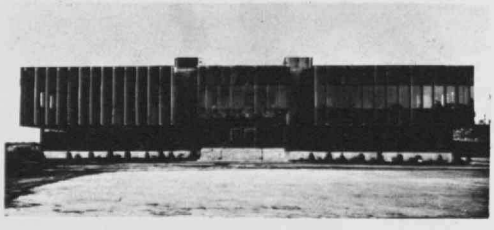
One of the worldwide leaders in management training introduces its two new training centers in Burlington, Massachusetts and Fort Washington, Pennsylvania. The first two buildings of their kind, they are prototypes of 22 other Management Centers to be built in major cities around the world. Construction on Chicago facilities will begin shortly.

Outside companies, agencies and associations can now utilize Management Center of Cambridge facilities for their own meetings, conferences and other functions.

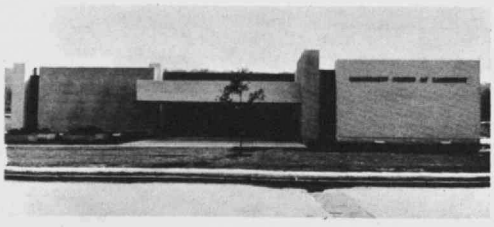
Each fully-carpeted building, designed for in-depth learning experience features:

• fully equipped rooms that can be arranged for theatre, schoolroom or director style seating • moveable, soundproof walls adjustable to accommodate groups from 10 to several hundred • complete catering facilities • large parking areas • modern offices, with or without secretarial services • and, in Burlington, an IBM 360/20 computer, Video Tape in all rooms and a Business Service department that has creative capabilities from layout through printing, addressing and mailing.

Inquiries about these and other facilities can be addressed to David O'Neill, Director, Seminar Operations.



National Headquarters
Middlesex Turnpike, Burlington, Mass.



Philadelphia Training Center
Fort Washington Office Center,
Pennsylvania Turnpike, Exit 26
Fort Washington, Pennsylvania

MANAGEMENT CENTER OF CAMBRIDGE

MIDDLESEX TURNPIKE, BURLINGTON, MASS. TELEPHONE (617) 272-3500

The little black box that makes you a whiz at signal processing

The CSS-3* is incredibly easy to operate. The unique software package lets everyone do real time Fast Fourier Transforms, digital filtering, correlations, convolutions, cepstra, amplitude histograms, signal averaging, and other special application-oriented digital signal processing routines. And after only a few minutes of training, too!

Make us prove it! For more information write: Computer Signal Processors, Inc., 209 Middlesex Turnpike, Burlington, Massachusetts 01803. Tel. (617) 272-6020.

cspi COMPUTER SIGNAL PROCESSORS, INC.

*CompuSignal System-3 Digital Signal Processor

Edited at the
Massachusetts Institute of Technology
Volume 72, Number 3
January, 1970

Technology Review, Reg. U.S. Patent Office, is published nine times each year (in October/November, monthly from December through June, and in July/August) at the Massachusetts Institute of Technology.

Inquiries regarding editorial contents, subscriptions, and advertising should be addressed to: Technology Review, Room E19-430, Massachusetts Institute of Technology, Cambridge, Mass., 02139. Telephone area code (617) 864-6900, ext. 4872.

Technology Review is printed by the Lew A. Cummings Company, Manchester, New Hampshire. Second class postage paid at Manchester, New Hampshire.

Price: $1.25 per copy, $9 per year in the United States, $10 in Canada and foreign countries. Please allow three weeks for changes of address, and give both old and new addresses in all requests.

Technology Review is represented for advertising by: Good, Laidley and White, 50 East 42nd Street, New York, N.Y., 10017, telephone (212) 986-6210; and by MediaRep Center, Inc., 1127 Statler Office Building, Boston, Mass., 02116, telephone (617) 542-7720.

The First Line

As the members of its community press for "relevance" of its activities to strongly-felt social goals, an academic institution today must make some hard—and tricky—decisions.

The committee planning the study of the nature and purposes of an M.I.T. education which is now beginning saw one dimension of the problem very clearly: "Are there conflicts between efforts to meet immediate social needs and the fulfillment of our long-term commitments in education and basic research?" was the committee's question which it proposed for the agenda of the commission to be guided by its report.

There are conflicts, indeed. Potential points of contact between technology and politics are legion for an institution devoting itself to useful knowledge and to "socially relevant" research. Can such an institution's faculty work at the interface between technology and social goals without having a partisan role in the political influences which shape the product of the effort?

And what then about a faculty's role in taking positions on issues in which it is involved through its members' political rather than professional perceptions?

The second issue—which is a significant extension of the first—came into prominence on many campuses this fall as faculties have been asked to record opposition to the Vietnamese war. At M.I.T., for example, a "sense of the meeting" resolution proposing "prompt and total withdrawal of American forces from Vietnam and immediate reordering of our national and international priorities" was before the faculty in October; the vote was 179 in favor, 102 opposed, and 53 abstentions—a decision of 334 of a total of over 1000 members of the faculty.

The resolution was explicitly political, and at least three different positions can be taken on the issue it raises.

In his supplementary statement as a member of the M.I.T. Review Panel on Special Laboratories last spring, Noam A. Chomsky, Ward Professor of Linguistics, wrote that "any act undertaken by M.I.T. in its public service function is a political act and must be considered with great care." Even accepting support from a public body "is, in effect, to make a particular political judgment, namely to support the existing structure of power and privilege. . . . In an institution largely devoted to science and technology, we do not enjoy the luxury of refusing to take a stand on the essentially political question of how science and technology will be put to use," wrote Professor Chomsky.

Three other members of the M.I.T. faculty —Professors Anthony P. French, Paul R. Gross, and Jerrold R. Zacharias—pointed out that the faculty's Vietnam vote was taken on a hastily drawn resolution, that the vote confused the merits of this particular language with "the whole question of whether this institution, officially and collectively, should declare a position on matters of national policy." Their conclusion: "We do not believe that the Institute should declare itself against ever taking a political stand, but we deplore actions that confuse the issues and undermine the sense of community that we, as a faculty, enjoy."

The most conservative view found expression in a *New York Times* editorial just preceding the October Moratorium: "A university should be dedicated to providing a sanctuary for the free exchange of ideas, without itself becoming either symbol or instrument of a particular political position," said the *Times*.

In these times of powerful pressures and strong emotions, can any university be effective in its social goals and yet adhere to its time-honored posture of scholarship? A 2000-year tradition which has served us so well is not to be wasted lightly.—J.M.

Next Month
Five articles in *Technology Review* for February, by Moises Behar, Alan Berg, the late Max F. Millikan, Dr. Nevin S. Scrimshaw, and Dr. W. H. Sebrell, Jr., will constitute a special report on protein malnutrition and its relationship to world food and economic problems.

Contents
for
January, 1970

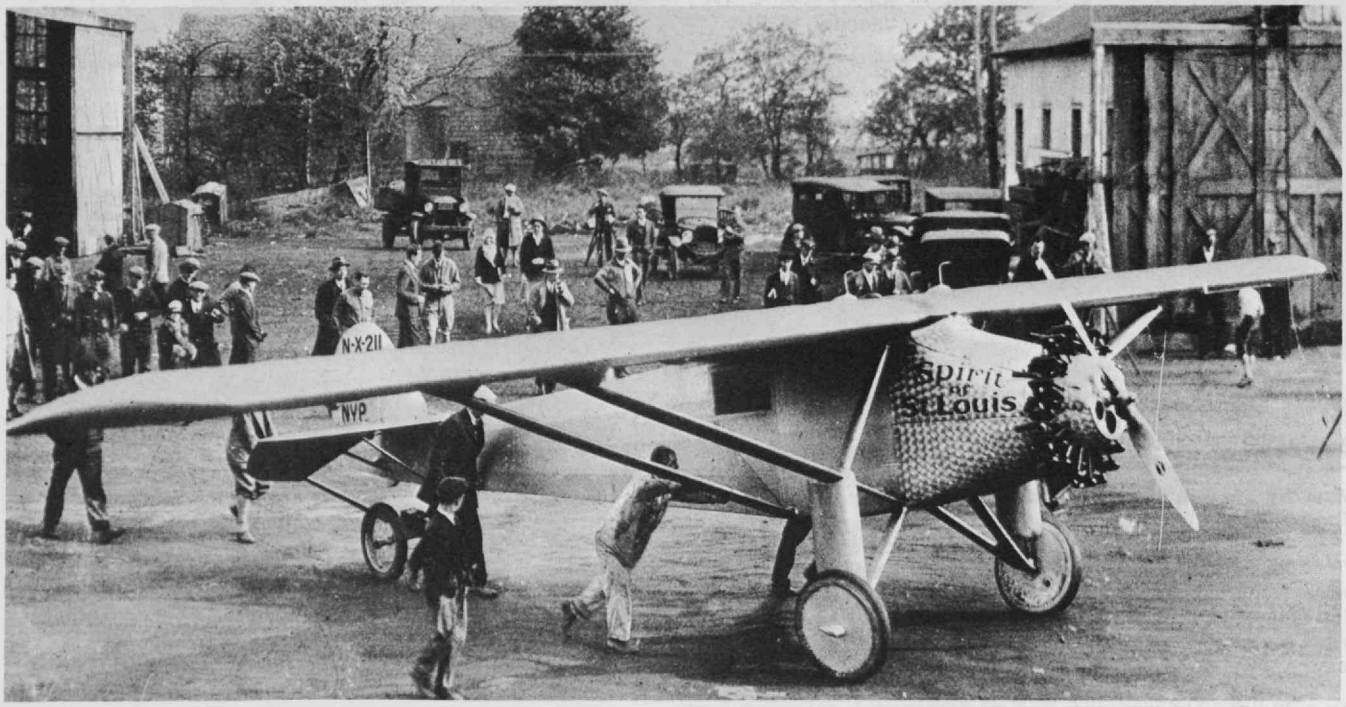
Technology Review

Articles

Departments

Trend of Affairs

Cambridge Journal



The Spirit of St. Louis is rolled from hangar as the Lone Eagle checks his charts.

Air pollution was the very least of aviation problems in Lindbergh's day.

Northern Research and Engineering Corporation is applying its broad experience in combustion and propulsion technology to the evaluation and control of air pollutant emissions from power conversion equipment. A recently completed report on aircraft engine exhaust emissions for the National Air Pollution Administration formed the basis for a report to Congress on the same subject. NREC is also pursuing actively designs for low-cost gas turbine vehicular systems which would reduce considerably automotive air pollution levels.

Our staff is currently active in the following areas of the air pollution field:

—Evaluation of automotive and stationary combustion systems as air pollution sources.

—Design and development of low-emission, combustion-driven power sources.

—Application, design and development of auxiliary air pollution control equipment.

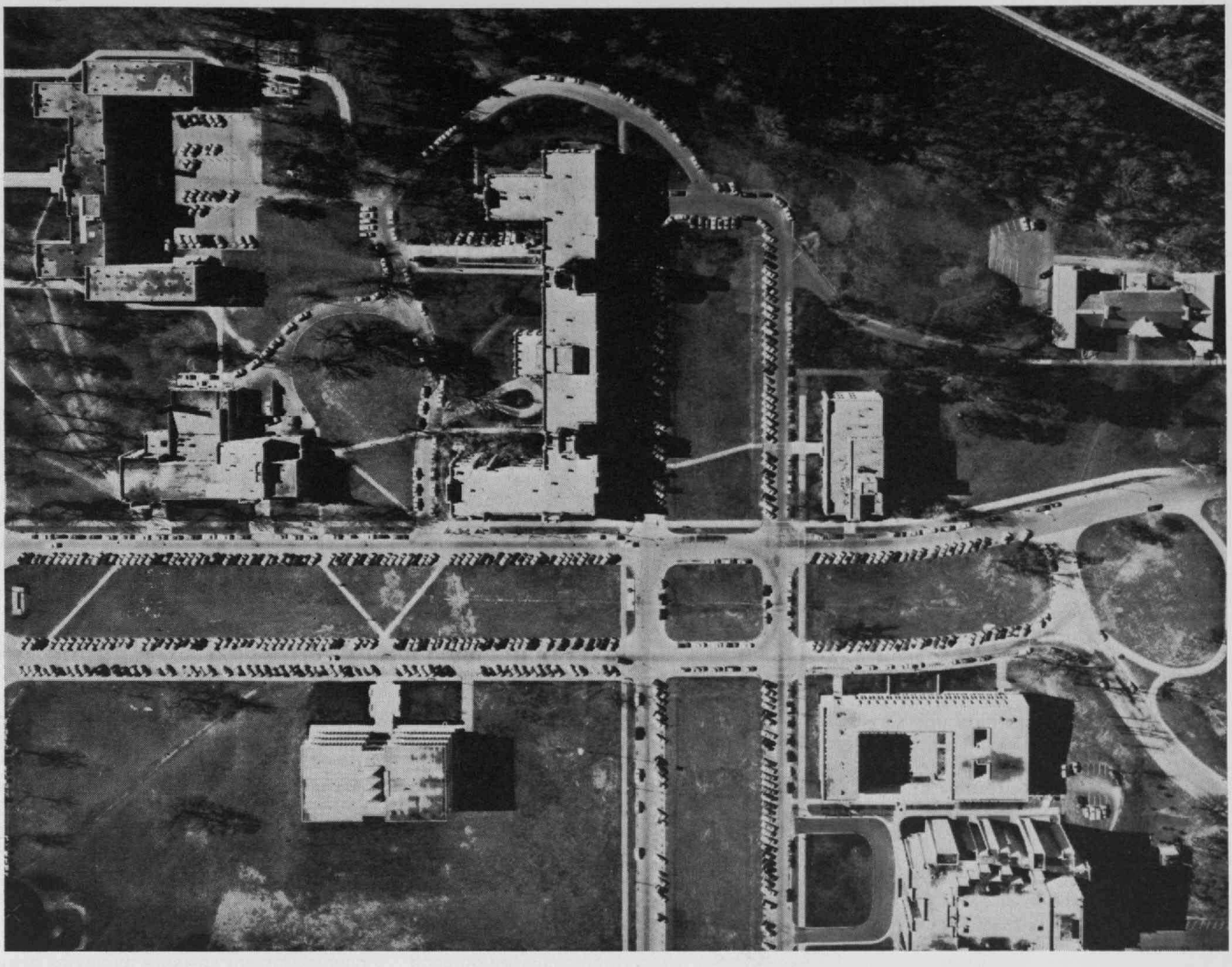
—Applied research in combustion processes related to air pollution formation mechanisms.

For further information, you are invited to write to the Marketing Department, Northern Research and Engineering Corporation, 219 Vassar Street, Cambridge, Massachusetts 02139, or to call 617 491-2770.

Northern Research & Engineering CORPORATION

PRINCIPAL OFFICES are located in Cambridge, Massachusetts and London, England.

SALES REPRESENTATION in Dayton, Ohio; Encino, California; Grenoble, France; and Washington, D. C.



What on earth are you doing?

Whether you're working on, above, or below the earth, the big picture—aerial photography—can help. All you need to do is apply photointerpretation to your frame of reference. Here are just a few samples.

If you farm, the big picture on infrared film might save your crop from blight. If you're in utilities, the big picture can show you the condition of your right-of-way. If pipelines are your problem, the big picture is the way to go to find where to go. Forestry—the big picture shows you all about all the trees; take your pick. With geology, the big picture gives you the lay of the land without a lot of foot slogging.

The big picture you get from aerial photography can benefit you, whatever your field. Send for your complimentary copy of *Photointerpretation and Its Uses*. This booklet, produced in part with screenless printing and stereo 3D, can show you some of the many advantages of aerial photography and photointerpretation. Send the coupon to Eastman Kodak Company, Dept. 412L, Rochester, N.Y. 14650.

EASTMAN KODAK CO. Dept. 114-1
ROCHESTER, N.Y. 14650
I would like to see if photointerpretation can help my business. Please send a copy of *Photointerpretation and Its Uses*— Code M-42.

NAME_____

COMPANY_____

ADDRESS_____

CITY_____

STATE_____ ZIP_____

OCCUPATION_____

Kodak

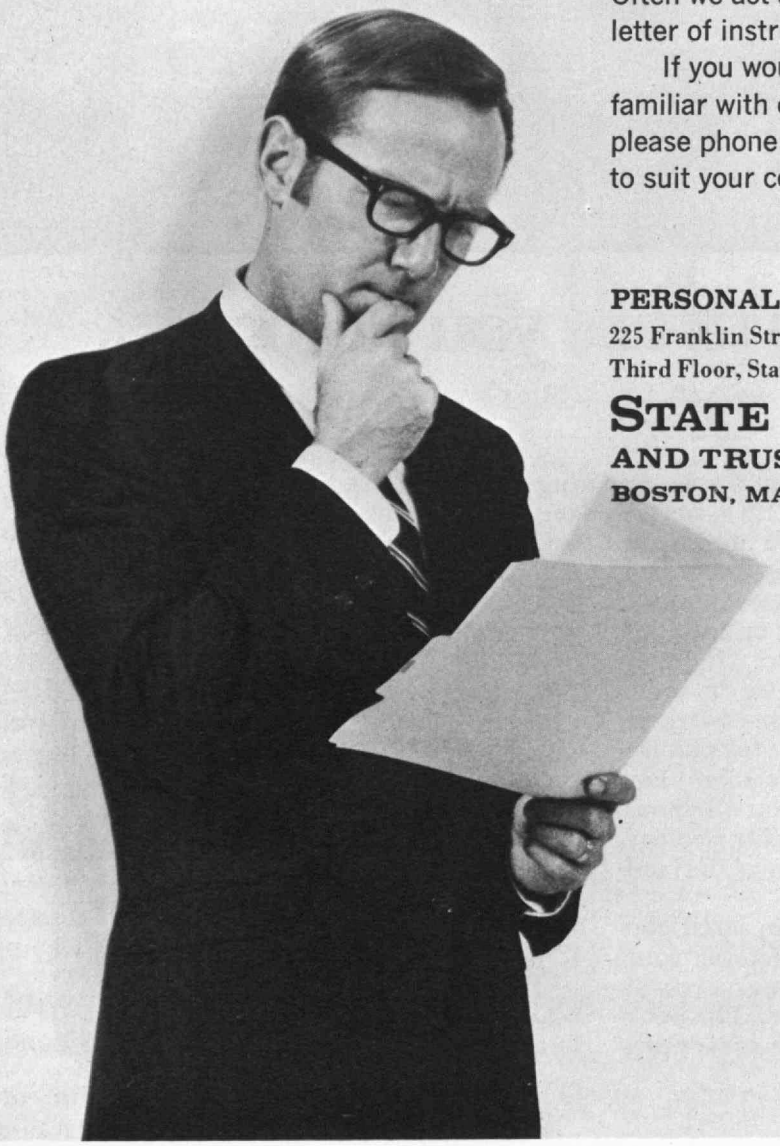
How can the serious investor outpace inflation– or even hedge against it?

It is true that common stocks do offer an opportunity to hedge against inflation. But it is an opportunity with definite conditions attached.

The job of investing wisely has become more and more complex—and not only for reasons of inflation. American industry is undergoing a period of immense change. Every business day brings news of corporate weddings and engagements, of proposals rejected or withdrawn.

The services of our Personal Trust Division reflect these changing times. An increasing and important phase of our responsibilities is now the management of investment portfolios during the owner's lifetime. Sometimes we serve as trustee under a revocable living trust agreement. Often we act as agent, under a simple letter of instructions.

If you would like to become more familiar with our here-and-now trust services, please phone 466-3721 for an appointment to suit your convenience.



PERSONAL TRUST DIVISION
225 Franklin Street
Third Floor, State Street Bank Building

STATE STREET BANK
AND TRUST COMPANY
BOSTON, MASS.

Information Flow and National Mood

After seven years of writing about science and government affairs in Washington, I am occasionally asked what it is like to do the same in London. The answer is that when I arrived here I was instantly impressed by the opacity of British public affairs, and now that I have had 18 months to learn my way about, I am even more impressed by that quality.

Journalistically, the difference between the two jurisdictions is simply this: In Washington, the division of government into separate branches, even if different parties do not control the legislative and executive—but especially if they do—automatically guarantees a fairly high minimum of contention. In the U.S. setting, politicians, administrators, and their various satellites look upon the press as an important part of the arsenal they employ for getting what they want. The press serves as a device for proclaiming plans or thwarting someone else's plans; summoning support, boosting or besmirching a particular figure, and—perhaps most important of all—appealing an adverse decision to the public at large.

In Britain, on the other hand, the leadership of the majority party in Parliament is the leadership of the ministries that make up the executive branch of government. Being one and the same in personnel, there is no conflict, outside of exceptional circumstances, built into the relationship between the two branches. On top of this, the day-to-day operations of the ministries is in the hands of a seemingly immortal corps of civil servants, who, by tradition, generally stay out of public view.

Lately, as a result of the Labor Government feeling that it might be beneficial to let some light into the innards of the ministries, some of these civil servants have begun to surface and speak and write publicly of their official responsibilities. But by and large, this is tame stuff, and the prevailing attitude of the civil servants is that the less said in public about government affairs, the better.

Then there is the amorphous though highly potent Official Secrets Act which the government can invoke when it feels that information deemed privileged has been made public. (Asked by a British journalist to describe the American equivalent of the Act, I replied, to his astonishment, that no doubt there was one, but during 10 years of reporting in Washington, I could not recall anyone worrying about it. A reporter who got a "hot" document could look forward to a prize, not a jail sentence, I told him.) And then there are the libel laws, largely annulled in the U.S. by recent Supreme Court decisions as far as public officials are concerned, but ever-present and often-used in Britain.

Finally, as one of Britain's venerable government science advisers recently explained in an interview, "Our tradition does not provide for a vast amount of public discussion prior to a decision being announced. This does not mean that there are no differences of opinion. Of course there are. But different factions do not customarily carry these differences to the public."

The Official vs. the Unofficial

Now, how does all of this affect the working journalist in the science and government field? One important way is that, in contrast to what happens in Washington, very little, outside of routine announcements, comes in through the transom. In Washington, for example, when a proposal starts to work its way through the bureaucracy or Congress, proponents will often seek to give it thrust by generating press notice through friendly reporters, while opponents will employ the same process to head it off. Thus, several years ago, when the National Institutes of Health was preparing a new grants manual following congressional criticism of the manner in which it supervised grantees, reporters concerned with the subject were deluged with leaked material, pro and con, on the deliberations.

In Britain, even the most energetic, diligent, and experienced reporters must concede that information about organizations dealing with comparable matters is mainly confined to official announcements and formal publications. Interviews with relevant civil servants are easily obtained—though a press officer will almost invariably monitor the conversation—but it is almost hopeless to expect such interviews to result in a departure from officially stated policies or the premature release of information.

The repercussions that can result from premature or unofficial release of information seem incredible by American standards. Last year, for example, a member of Parliament gave a newspaper reporter a proof copy of parliamentary hearings on Britain's chemical and biological weapons research. The hearings were unclassified, the document itself had been reviewed and approved by the Ministry of Defense, and formal publication was only a matter of weeks away. It was a rather commonplace incident in terms of what goes on in Washington, where few congressional documents are not leaked all over town prior to publication day. In the British case, however, the M.P. was brought up on formal charges of breach of parliamentary privilege and was formally censured by the House of Commons. The reporter and the editor of the newspaper involved could have been fined or jailed, but they got off with reprimands. A few months later, the M.P. failed to obtain reappointment to the parliamentary committee that had conducted the hearings.

British journalistic colleagues have complimented me for, as they believed it to be, ferreting out a good deal of internal government correspondence and memos on the Mohole episode and other matters that I have written about in recent years. They were astonished when I explained that most of this material was taken from publicly available congressional reports and hearings. And when I explained that the remainder was not simply given, but thrust upon me by interested parties, both in and out of government, they were even more astonished. "It doesn't happen here," was the sum of their remarks; and indeed, it doesn't.

Turbulence vs. Agreement

A key question, of course, concerns the effects that are produced by these differing national press mores. Britain, it strikes me, is a stable and relatively prosperous country that exhibits a large measure of general agreement on most important issues of public affairs. Quite possibly, access to the inner sanctums might produce the finding that things are pretty much as the official announcements make them out to be. I doubt this, but it is more likely to be the case than in the United States, where blatant lying and dissembling by government are a well-established feature of America's turbulent public affairs. The only antidote is to nail them, but the formula for this antidote is nowhere to be had but in the unruly processes that have come to prevail in the flow of information. The shame is that easy access to information, especially through self-serving leaks, tends to make reporters lazy and comfortably vulnerable to manipulation. But that's another story.

Daniel S. Greenberg, who will write occasionally for Technology Review *this year, is stationed in London as Foreign Editor of* Science.

"Persistent pesticides spreading through the environment do harm wildlife. This raises a serious question about what this insidious pollution might one day do to man . . ."

Making the World Safe for Man

If you're an average American and afraid of cannibals, take heart. You're inedible. Your body has a higher concentration of DDT than the U.S. Food and Drug Administration allows in meat.

Apart from being cannibal-proof, though, it's hard to see what comfort this gives you. While no one knows whether or not it undermines your health, your DDT concentration is another indicator of the spread of this material and similar long-lived organochloride poisons throughout our environment. This spread definitely endangers wildlife and may well threaten man.

Long simmering concern over DDT erupted in such a spate of restriction during 1969 that world thinking on pest control appears to have turned a corner. Merely to list some of the actions taken is impressive.

Sweden caught world attention last spring by announcing sweeping restrictions to take effect on January 1. Henceforth, every use of aldrin and dieldrin is banned. DDT and lindane can't be put in preparations for use at home, in house or garden. All other DDT uses are banned for a two-year test period during which research might show what a total ban could accomplish. Denmark, too, has banned it.

Actually, Sweden was not the first European country to take such drastic action. Hungary, with no fanfare, had already banned all organochloride insecticides. And a number of countries had banned aldrin and dieldrin, either as seed dressings or, as in the Soviet Union, totally.

Britain, having greatly restricted aldrin, dieldrin, and heptachlor, has taken a long look at the pesticide picture. At this writing, the Advisory Committee on Pesticides and Other Toxic Chemicals was expected soon to recommend further restrictions at least as tough as those of Sweden. DDT use has already dropped off so much in Britain that no one makes it there any more. What little is used is imported, mainly as part of specialized products.

In America, Canada cut back DDT use by 90 per cent in regulations effective January 1. It can be used for controlling insects in forests, parks, and other outdoor areas only under emergency conditions. It can be used on only 12 crops compared to 62 formerly.

And in the United States, Michigan banned DDT, and Arizona suspended its use for a trial year. California, after Jan. 1, cut its use by 50 per cent, banning it totally from households and home gardens.

The Demerits of Ecological Poisons

So the trend runs strongly against what Dr. Norman W. Moore calls the mistaken strategy of hoping to benefit mankind with ecological poisons. Head of the toxic chemicals and wildlife division of Britain's Nature Conservancy, Dr. Moore was one of a number of world-recognized pesticide authorities called in by Sweden before DDT was banned.

These experts held what amounted to a special symposium for the benefit of Swedish authorities, including some cabinet ministers. They presented evidence of potential danger from the poison and debated the merits of banning it. Scientists representing many shades of opinion spoke. Dr. Moore says the discussions were impressive for their breadth and fairness. Only after listening to all this did Sweden's National Poisons and Pesticides Board make up its mind. The deliberation that went into the decision is what has given Sweden's example so much weight.

First synthesized almost a century ago, DDT has been widely used only for three decades. Men thought they had a marvelous chemical helper. It's deadly to a wide variety of pests. It stays around once applied. And it's cheap. Its use has boosted food production worldwide. It has greatly reduced public health hazards from insect-borne diseases. But its virtues are its vices.

To begin with, DDT is much too effective. It's just plain poison for virtually all animal life. It breaks down so slowly in nature that it can escape its areas of use to permeate the whole of Earth's living world. It evaporates and moves with the winds. It seeps with ground water. It moves into food chains, often becoming more concentrated in the process. It's found in Antarctic snows and fauna. It's traced far out at sea. And, as previously noted, we carry it about in our bodies.

DDT and similar poisons don't have to kill outright to be dangerous, as wildlife studies now amply show. Worldwide decline of eagles, falcons, and some other hawks have been proved to be due to mild poisoning—to the extent this can ever be proved. Studies made in the wild show very poor success in reproduction. Egg shells are abnormally thin, compared to specimens in museums. They break easily. Parent birds tend to destroy them. Even when left intact, such eggs often fail to hatch. Laboratory tests show that sublethal doses of DDT will cause birds to lay this kind of abnormal egg.

Ichthyologists find equally subtle pesticide effects lowering reproduction rates of some fish, such as Great Lakes salmon. Sublethal DDT doses also alter normal reflexes of some fish in deleterious ways, to judge from laboratory experiments.

Hooked on DDT

Enough such effects have been identified to show quite conclusively that the persistent pesticides spreading through the environment do harm wildlife. This conclusion raises a serious question about what this insidious pollution might one day do to man, even though there have been no known cases of death or illness due to the poisons other than through obvious mishandling.

This is the telling difference between the organochlorides and many other pesticides man now uses, including the highly toxic organophosphorous compounds. Spectacular accidents like last summer's poisoning of the Rhine grab headlines. However, the poison which killed millions of fish, a poison thought to have been an organophosphorous pesticide, should have broken down quickly.

"Nature," Dr. Moore observes, "is used to dealing with local catastrophes . . . But when you use something like DDT that spreads over the whole environment, that's a different matter. . . . I'm not the least antipesticide myself. But there's a real qualitative difference when you have no control of them." Considering all this,

Dr. Moore feels all countries who can afford to do so should stop using these ecologically damaging pesticides.

Unfortunately, many poorer countries are hooked on DDT, since it's still the cheapest bug killer around. To stop using it would mean trouble for agriculture and public health control. Bans by some countries, then, will only slow world DDT pollution, not stop it. You could argue that national bans might be futile. But, as Dr. Moore noted when asked about this, "If we all take this view, nothing will be done."

A New Approach to Pesticides

This seems to be the consensus that experts have come around to. And the bans imposed in 1969 suggest that public authorities increasingly agree that the long-lived poisons have to go. This is the corner which the world attitude toward pest control seems to be turning.

However, some experts already are standing at what they think to be the next, and even more important, turn that must be taken. They want men to rethink completely their attitude toward pest control. They feel that heavy reliance on poisons, persistent or not, is a dangerous mistake. Present methods are wasteful in that they don't even make the best use of the chemicals. Also, they kill off beneficial insects and breed poison-resistant pests. In the long run, they could leave men facing a host of resistant pests with no controls at all.

Dr. K. Mellanby, head of the Monks' Wood Experimental Station of Britain's Nature Conservancy, says farmers spend much more than they should on pesticides by using these often-expensive chemicals indiscriminately. Wise pest management for its own sake requires minimizing the crop dusting and spraying. And it requires waking up to the fact that you don't have to wipe out all the bugs to get effective control.

Dr. Mellanby told the 1969 annual meeting of the British Association for the Advancement of Science, "Pests may exist in small numbers in a crop and may not reduce yield at all. Here there is no point in using an insecticide. A slightly higher infestation may reduce yield, but the crop loss may be less in value than the cost of using an insecticide. . . . A high proportion of insecticides and herbicides are in fact used unnecessarily."

Biological control can help too. Its methods range from using bugs to fight bugs to making pest species sterile with radiation or genetic manipulation. Such measures have already brought some 110 pests in over 60 countries under some degree of control.

In cash terms, such control has paid off handsomely. From 1928 to 1963, the (British) Commonwealth Institute of Biological Control spent about £1 million on research. The Institute estimates that seven of the projects gave savings of £5 million during that period plus subsequent annual savings of £250,000. To quote an American study, University of California control experts figure five of their projects saved farmers $113 million up to 1959 plus $10 million a year since then. That was on a research investment of $4.25 million between 1928 and 1959.

Sometimes biological control alone can keep a pest in check. Other times it needs chemicals to help. And sometimes it won't work at all. Most experts see chemicals underpinning pest control indefinitely for several reasons. Men have already mucked up natural insect controls so much that poisons are often the only recourse. Infestations can explode so quickly that biological measures wouldn't have time to act. Controls may not be found at all for some crop pests. And for whole classes of problems, such as those posed by disease-carrying insects or nematodes, no biological control now looks promising.

No Other Way Out

We need a balanced approach to pest control, one that makes maximum use of biological methods and minimizes poisoning. Getting it will take an order of magnitude boost in research, which is what at least a few experts like Dr. Mellanby are shouting for. Western countries alone spend over $84 million a year on pesticide research and $1,440 million for the poisons themselves. Since these figures are several years out of date, the amounts may be even greater now. The roughly $10 million a year spent on biological control seems piddling by comparison.

Banning DDT and other organochlorides may halt one insidious form of pollution. But we'll be kidding ourselves if we think to solve our pesticide problems with that. Even the experts have only vague ideas of what present pest control measures are doing to our environment. And no one knows how to put together a really wise pest management strategy. This is a complex, increasingly urgent problem calling for massive research that has scarcely begun to be undertaken.

Last March in this column, I quoted an assessment of this challenge by Boysie E. Day, Associate Director of California's Citrus Research Center and Agricultural Experiment Station. It's worth repeating here:

"We organize thousands of experts and spend billions to put men on the moon," he said speaking of the United States. "We have to make comparable efforts to deal with a complex situation like pesticide contamination. There is no other way out. We simply have to know what we are doing. We have to seek solutions on the basis of facts and not of public emotion. We can't dodge this responsibility by looking for simple solutions. And that's what people are doing when they want just to outlaw a chemical."

Robert C. Cowen, Science Editor of the Christian Science Monitor, *is writing from the* Monitor's *London office in 1969-70. A Past President of the National Association of Science Writers, he will receive the American Chemical Society's Grady Award late next month.*

"If we are all truly serious about using man's intelligence to weigh and develop livable alternatives, government must get about developing the practical political tools."

Good Environment and Good Politics

We show occasional signs of wanting to rise from the muck to live with more intelligence in our crowded, limited world. Either we will do so, it is clear, or the muck and miasma of spoiled environment and life without beauty will ultimately choke and destroy us.

More people now realize this. Good environment is becoming good politics in some parts of the country. The kids who have been up tight about war now tell us they are up tight about the environment.

Obviously, the small number of scientists and technologists who have been preaching environment have begun to get some results. Barry Commoner of Washington University, long-time Jeremiah, finally found himself on a platform of the conservative American Chemical Society a few months ago, suggesting before many industrial chemists that it was time the Society made an official gesture toward Rachel Carson, whose preachments its journal derided. He also traded polite but pointed discussion with Lee A. DuBridge, the President's Science Adviser, and cautioned Dr. DuBridge—who had just pledged more federal help to build efficient sewage disposal plants—that extending present sewage disposal methods will keep choking our waters with algae-promoters.

Matthew Meselson of Harvard, a geneticist with a file cabinet full of material on biological and chemical warfare (*see* Technology Review *for October/November, pp. 103-104*) who has long been regarded as just another crank scientist by much of official Washington, found himself hailed in late November as the man who "more than any other individual" helped influence President Nixon's decision to junk biological weapons.

Both Dr. Commoner and Dr. Meselson have magnificently helped demonstrate what the former recently called scientists' "new responsibility to teach their fellow citizens what they need to know" about the environment. The radioactive fallout debate of the 1950's and 1960's, said Dr. Commoner, "showed that with such help from the scientific community the public could be informed. Once informed, the public generated its own moral response."

Including one understandable response very recently: that of Miss Stephanie Mills. Miss Mills is a dignified 22-year-old who (to quote the New York Times) "jarred the Mills College commencement at Oakland last June by announcing, as valedictorian, that she did not intend to bring any children into this muddled world." Miss Mills next appeared on the Stanford campus in late November to address 200 college students from 40 campuses meeting to form a federation to seek improvements in "the quality of life." Having become a worker for Planned Parenthood, she now wore a set of curlicue-shaped plastic earrings: intrauterine contraceptives.

Beginning the Destruction of Man

With all due respect to this kind of idealism, there must be better answers than plastic-earring negativism. IUDs yes, childlessness no. Otherwise we acknowledge that the destruction of man has already begun.

Inevitably the better answers have to be political answers. Enter Washington.

There is more and more questioning in Washington today of the wisdom of the federal agencies that make so many of the decisions that shape our environment. More people are asking: do the decision-makers really know the future effects of all our new:

Pesticides.
Food additives.
Sewage and fertilizers which clog streams and lakes with phosphates and nitrates.
Life in smog.
Life in a world enveloped by CO_2.
Nuclear power.
Underground atomic testing.
Offshore drilling.
Arctic drilling and oil spills in icy waters and permafrost.
Giant tankers with potential for giant disasters.
Proliferation everyplace of the automobile and the airplane.
SST's.
LSD.
The many other chemicals in our daily lives which may affect genes.
Birth control pills and other powerful, commonly gobbled drugs.
Present and approaching biological engineering.

Wanted: An End to the Floundering

We can readily go on and on. The point is: How can government get some guidelines at least to tell it whether to finance new sewage plants or put money into developing other sewage controls? Whether fossil-fueled or nuclear-fueled plants will least violate the environment?

The questions, like the problems, are almost endless. Almost all involve imperfect alternatives which we will just have to accept. We are not all going to start wearing IUD earrings to say, "We cop out." Yet the present floundering is acute. Citizens of Minnesota, Maryland, Maine, New York, New Jersey and elsewhere are now demonstrating against the radioactivity of nuclear power. Citizens of Orange County, California, are demonstrating against the pollution of fossil power and complaining of tardy development there of nuclear power.

Early in 1969 the Atomic Energy Commission announced that a "safety review" had foreseen no substantial risks in greatly expanded underground nuclear tests necessary to develop the Safeguard anti-missile warhead. Almost immediately Kenneth Pitzer, President of Stanford University who was formerly A.E.C. Director of Research, called for "much more substantial public hearings." He pointed out that both central Nevada and the Aleutians—U.S. test sites—had earthquake histories. He urged study by "an impartial judge and jury" of independent experts without A.E.C. affiliation, rather than study conducted "primarily in closed circles, with the effective judgment rendered by officials committed to the test program."

Such study, he said, should be followed by a major public hearing, *after which* "Congress, governors, and other responsible officials as well as the interested public can form their own judgment, balancing . . . risks against the need for tests." Of course the ultimate decision would still have to be made by the President, but he might in this way be able to make a decision before the preparations and pressures have gone so far that retreat from the testing would be a major political embarrassment.

Dr. Pitzer then went on to say: we ought to follow the same practice in many government decisions that affect earthly ecology. Far too often these decisions are made in closed circles, in unpublicized meetings, by boards of officials and consultants largely composed of government agencies or their closely-linked agents.

The Case of an Astrodemic

For another example: the decisions on quarantining astronauts and examining moondust for evidence of any organisms or materials that might harm man. These decisions were made—without open publicity until the very eve of first flight—by the space agency, with the advice of only an Inter-Agency Committee on Back Contamination, with members only from federal agencies (H.E.W., Agriculture, etc.) with the exception of one biologist named by the National Academy of Sciences.

The precautions finally established were considered wildly overdone by some scientists (largely physical scientists) but grieviously incomplete by some others (mainly biologists) *in the event that moon germs might really be present.* No one really expects to find germs on the moon—though, it might be pointed out, we have already found a few other phenomena there which no one expected. The real danger to Earth, biologists generally agree, could come when and if men return materials from Mars. This day could come as early as the 1980's.

This danger, if it is a danger, would affect not just the United States or the Soviet Union but mankind. "Because all people will suffer if an astrodemic occurs," argued the University of Missouri's Dr. Solomon Garb during the height of the lunar controversy, "elementary fairness requires a broadening of the debate. The decision about the risk to earth of any round trip ought not to be left to a space agency, committees appointed to it, or related government agencies. A judgment upon which the future of all life on Earth may depend should be made openly, after careful debate and consideration, by representatives of all peoples."

So we may say (if we agree): all arbiters of earthly ecology ought, at the very least, to consider advice from authorities outside the pressure cooker of official Washington. The ordinary Doctor A in the Department of Health and the ordinary Doctor B in the Department of Agriculture, making a decision profoundly affecting the Department of Space, cannot help but be affected by political considerations—which is to say questions pertaining to the political world, which is to say the world of practical, difficult, day-to-day government action which inevitably colors every one of Washington's scientific and technical decisions.

The Politics of Assessing Technology

In such practical terms, then, what should the government do to achieve better decisions about technical problems?

This is now one of the most important, if so far least noticed, discussions in Washington, in large part as the result of some actions by the cool and hard-working Representative Emilio Q. Daddario, Chairman of the House Science, Research and Development Subcommittee.

Rep. "Mims" Daddario, who deserves a column in himself, threw into the hopper a bill to establish a formal government vehicle for "technology assessment." His bill would establish a Technical Assessment Board, but this is not about to be established tomorrow. The representative from Connecticut intended his bill as a "stimulant to discussion."

The House Science and Astronautics Committee, at his suggestion, also asked the National Academy of Sciences, the National Academy of Engineering and the Library of Congress to suggest methods to weigh the benefits and risks of new technology, then get these assessments meshed into public decision. All have issued reports suggesting promises and pitfalls (*see page 58*).

Speaking for himself, Dr. Pitzer has further suggested establishing a new committee within the Executive Office of the President to forecast effects of new technologies. Dr. William McElroy of the National Science Foundation has volunteered that N.S.F. ought to be the agency to move into technology assessment—initiating necessary research, letting assessment contracts to private agencies, advising the President.

The actual nuts and bolts of such assessment—whether it must include pilot studies, how extensive such studies should be, and many other difficult questions—must be the object of detailed examination, which this column will not now undertake.

Let this, however, be said. If scientists and technologists are serious about protecting society and the environment, they must, in Dr. Pitzer's latest words, "express the need and be willing to back up such a program by their own commitment, institutional and personal."

Expressing the need must have first priority, it seems to me, if official Washington is to notice. "Technology assessment" is not a very sexy phrase, and it has not yet appeared in very many headlines or political speeches. Now the Commoners and the Meselsons are needed to tell the people, the Congress, and the President that if future muck is to be prevented, if we are all truly serious about using man's intelligence to weigh and develop livable alternatives, government must get about developing the practical political tools.

Victor Cohn, Science Editor of the Washington Post, is receiving Honorable Mention for newspaper writing on the Apollo 11 moon landing in the annual competition for George Westinghouse Science Writing Awards conducted by the American Association for the Advancement of Science during the A.A.A.S. meeting in Boston at the end of December.

National Report
Victor K. McElheny

"The Apollo transportation system is open for business . . . and after only two of the manned Apollo landings . . . the moon is turning into a planet of surprises." Here is a summary of some of them.

Lunar Exploration: Curiouser and Curiouser

The adventure of lunar exploration is beginning to look like a play that becomes more exciting after the bright lights are switched off and many of the spectators have gone home.

The moon is turning out to be like the moon, subtly different from any other body in space and thus more likely than we might have expected to throw the properties of our own planet into strong relief.

One spot on the surface of the moon differs from another—in age and chemical composition—indicating that the processes which shape that surface are not uniform and take place over long periods of time.

After only two of the manned Apollo landings on the moon—about which so much was written in advance that any curiosity could have been stifled—the moon is turning into a planet of surprises. An increasing number of these surprises can be expected over the next few years as American astronauts land at a planned total of eight more sites and as the avalanche of lunar ballyhoo thins out.

Now that Neil Armstrong's landing has been followed by Pete Conrad's, it can be taken that the Apollo transportation system is open for business, even though engineers will have to refine the lunar landing procedures continually to give later teams of astronauts every possible second of maneuvering time needed to touch down at sites both more mountainous than the Sea of Tranquility and the Ocean of Storms and further away from the lunar equator.

Increasingly, public attention will turn away from how the astronauts get there and back and toward the scientific adventure they find on the surface of another world. The astronauts have shown that they are ready for it.

A Different Planetary Cloth

On their outdoor sojourn of two and a half hours last July 20 and 21, Armstrong and Edwin Aldrin performed such significant tasks as setting up a seismometer which showed the moon to be 100 to 10,000 times quieter seismically than the earth, picking up rocks that cooled for the last time at least 3 billion or as much as 4.6 billion years ago, and photographing glass-lined pits in rocks and glass spatter on the ground whose origin is mysterious.

The chemical composition of the material from the Sea of Tranquility generally confirmed some two years of reanalysis of the readings from the unmanned scientific spacecraft Surveyor V that soft-landed nearby in the summer of 1967. Those readings indicated that, although the material of this barren lunar "sea" generally resembled basalts found on Earth, it contained far more of such elements as titanium and chromium and far less of such elements as sodium and potassium.

In December, the National Aeronautics and Space Administration published a summary of these findings called *Apollo 11 Preliminary Science Report* (available from the Clearing House for Federal Scientific and Technical Information, Springfield, Virginia, 22151, $3).

In discussing the chemical analysis of lunar samples, scientists Wilmot N. Hess and Anthony J. Calio note that the moon seems to be covered with a layer of planetary cinders:

"There is no similar material common on Earth. Several of the refractory metals are very prominent. On Earth a deposit containing from 5 to 10 per cent titanium is rare and might be considered a titanium mine. Zirconium, yttrium, and chromium also are present in amounts substantially larger than might be expected in terrestrial basalts.

"Another characteristic of the samples is that they are low in alkali and volatile elements such as sodium, potassium, rubidium, lead, and bismuth.

"Aside from this characteristic and the very low water content mentioned previously, the material might be considered similar to terrestrial basalts. Because of the enrichment of the refractory elements and the depletion of the volatile elements, it is tempting to consider the material to be similar to a cinder, being the end product of high-temperature environment, to explain these modifications."

In short, Armstrong and Aldrin had not been visiting a place that was cut from the same planetary cloth as the earth, nor formed according to processes commonly seen on it.

Seeing a Range of Time

While they were on the lunar surface last November 19 and 20, Conrad and Alan Bean worked outside for two periods of four hours each and could easily have stayed outside their lunar module on the Ocean of Storms for a couple of hours longer.

After it was over, the astronauts said they were sorry they could not have had more flexible joints in their suits to allow them to bend more freely and work faster, and they lamented that during their second moonwalk they could not have stayed in one spot and studied it intensively. During that moonwalk, they carried out an elaborate geological traverse according to a detailed plan worked out with geologists on Earth and visited the spacecraft Surveyor III, some 600 feet from their lunar landing craft.

The 75 pounds of rock samples that Conrad and Bean collected arrived at the Lunar Receiving Laboratory of the N.A.S.A. Manned Spacecraft Center in Houston Nov. 25 and were promptly subjected to a less nervous and swifter preliminary analysis of the sort given to the Apollo 11 samples.

Until the samples were actually tested, the best guess scientists had was that they would represent rocks older than those of the Sea of Tranquility but of roughly similar composition. But the result was quite different.

Professor Oliver Schaeffer of the State University of New York at Stony Brook announced in Houston December 12 that the preliminary results of dating rock samples by the potassium-argon method showed an age between 2.2 and 2.5 billion years, half a billion to a billion years younger than the Sea of Tranquility samples, whose ages since crystallization run between 3 and 3.8 billion years by this method.

This was so, Schaeffer said, even though tests of how long the Ocean of Storms

material had been exposed at or near the surface to cosmic rays gave roughly the 100-million-year figure of the Sea of Tranquility.

S. Ross Taylor of the Australian National University said the materials from the Apollo 11 and Apollo 12 sites, some 950 miles apart, resemble each other more than they resemble anything else, even rare types of meteorites. But they still only have a "first cousin" relationship to each other, Dr. Taylor said, adding that the material from the Sea of Tranquility and the Ocean of Storms could represent the extremes of "sea" conditions that will be found on the moon.

William Greenwood of the Lunar Receiving Laboratory said excitedly that getting two widely separated dates from the first two lunar landings was spectacular for scientists. "This tells us sequences," Dr. Greenwood explained. "Now we're starting to see a range of time on the moon."

David R. Wones, Associate Professor of Geology at the Massachusetts Institute of Technology, said that of the 46 rocks brought back on Apollo 12, the largest weighing six pounds, only two were of the angular conglomerate type known as breccia. Three-fourths of the rocks hastily gathered up by the Apollo 11 astronauts had been breccias.

The amount of glass in the Apollo 12 samples was less than in those of Apollo 11, Professor Wones said. He was impressed with the "tremendous variety of textures" in the Apollo 12 samples, including rocks which cooled both swiftly and slowly.

Wones and Taylor both noted the smaller percentages of titanium in the Apollo 12 rocks. The fines, which Taylor said were high in nickel content and therefore could be meteorite fragments, had about half the Apollo 11 titanium percentage of 4.2.

The fines and the two breccia rocks of Apollo 12 were generally similar and distinct from the other rocks. The Apollo 12 samples of rocks were not only lower in titanium but also in zirconium and yttrium than the Apollo 11 rocks.

David O'Kelley of Oak Ridge National Laboratory said that the proportions of potassium, uranium, and thorium found in six crystalline rocks was much lower than in the Apollo 11 samples.

Wones noted fragile fragments with "volcanic textures" in the Apollo 12 material.

Throw the Book Away and Begin All Over

The rock samples were not the only achievement of Apollo 12. The astronauts also set up the first automated geophysical station on the moon, with an expected lifetime of at least a year.

Four of the five experiments in the station began giving results swiftly. A fifth, to measure temporary lunar atmosphere, gave trouble for several weeks and scientists were uncertain whether it would work properly.

The lunar surface magnetometer, the first such instrument to be placed on the moon, continually gave a reading of a magnetic field at the surface of about 30 gammas, more than three times the maximum indicated by a similar magnetometer aboard the moon-circling U.S. satellite Explorer 35. A gamma is about one ten-thousandth of the strength of the magnetic field at the surface of the earth. The moon's lack of a strong magnetic field is taken as a sign that the interior of the moon is cool and may always have been. The finding of an unexpectedly strong magnetic field now creates new problems, according to Dr. Palmer Dyal of N.A.S.A.'s Ames Research Center in California.

It is not known whether the field originates in some local formation, perhaps the hunk of iron or nickel which slammed into the interior of the moon and formed a nearby "mass concentration," or from the whole moon. This question cannot be answered, said Dyal, until a network of magnetometers is deployed on the lunar surface. The first opportunity for another magnetometer is on the Apollo 15 flight next fall.

The most spectacular finding from the instruments, however, came on the afternoon of November 20 when the upper stage of the lunar module Intrepid, which had borne Conrad and Bean from the surface to a rendezvous with their colleague Richard Gordon, was sent crashing into the surface some 40 miles from the Ocean of Storms landing site.

This act, which foreshadows attempts on the Apollo 13 flight in March and the Apollo 14 flight in July to send the third stage of the Saturn V rocket crashing into the moon, caused an impact which sent reverberations to the Ocean of Storms seismometers for 55 minutes.

These signals, which arrived at intervals of 1 to 1.5 seconds, increased in amplitude for some seven minutes before they started tapering off.

The reverberations may have been caused by sound waves bouncing around in an entirely gas-free and water-free layer of rubble that may lie between two lava "plates" in the area, according to the chief scientist of the seismometer project, Gary Latham of Columbia University.

"It's a very unusual circumstance, "Dr. Latham said less than an hour after the reverberations started, "and unquestionably profound relative to the lunar structure in that region. But since it's not something we've observed in the past, we're going to have to throw the book away and begin over again. Which seems to be the case for the moon in general."

Frank Press of the Massachusetts Institute of Technology was almost breathless in Houston when he arrived at the N.A.S.A. press headquarters. "This only happened a few minutes ago. In fact it is still happening," he said. "So we have been exploring hypotheses walking over here (to the press conference). Usually when we speak too soon, we are wrong. But none of us has seen anything like this on Earth. In all of our experience it is quite an extraordinary event."

"A Good First Step"

The announcements of these startling brand-new facts about the moon took place in an atmosphere of greatly improved relations between scientists and engineers in the lunar exploration program. The scientists felt that they had learned more about N.A.S.A. procedures, that the engineers had learned more about getting them "into the loop" of planning and executing a lunar mission.

But this does not mean that men like Eugene Shoemaker of the California Institute of Technology, who is leaving the Apollo geology program after 10 exhausting years of battling with N.A.S.A., are unsaying the harsh things they have been saying.

Right after Apollo 12, Professor Shoemaker said that it was only "a good first step. They have a long way to go to prove man's utility."

Shoemaker said N.A.S.A. needs to push hard immediately for more intense exploration of the moon in preference to a hell-for-leather effort on space stations and space shuttles. "They need to take the Apollo system and put money into it and put man on the surface and back him up so he can work there for a week."

To be effective within a huge organization like N.A.S.A., said Professor Shoemaker, a scientist has to be willing to give all his time to inevitable battles. "I'm not saying there's something wrong with the system. It's just a big system. I don't have any illusions. It won't be easy to change."

Victor K. McElheny, Science Editor of the Boston Globe, *has followed the Apollo program closely and been at the Manned Spacecraft Center in Houston during both Apollo 11 and 12 flights.*

Give us a mind that's never complacent, never satisfied, never satiated.

We'll give you a job you'll never want to leave.

We'll give you a job as an RCA systems programmer. A job that will help turn your thoughts into reality. You'll have a voice in hardware design. A variety of projects to test your intellectual flexibility. A group of people to work with who speak your language.

We'll give you goals that are sometimes definite, sometimes vague, but always stimulating. And, we'll give you rewards and advancement commensurate with your skills.

Specific openings include:
SYSTEM ANALYSTS. Experienced in shaping the architecture of a product, in considering the trade-offs, and in finding the basic structure which makes the hardware-software interface tractable.

OPERATING SYSTEM IMPLEMENTORS. Individuals who have been through a major software product cycle and are now ready to do the interesting parts they had to leave out before.

OPERATING SYSTEM IMPLEMENTORS. Experience in input output and data-management interfaces.

SYSTEMS ANALYSTS AND DESIGNERS. Individuals who are interested in measuring, simulating, analyzing and testing the real performance of software-hardware combinations and contributing to architectural design.

Whether your interest is at the programmer or manager level, there is room for you at RCA Marlboro.

To arrange an interview, call Mr. D. J. McPhee at (617) 481-1500. Or send a resume to him at RCA Information Systems Division, Dept. TR-1, 200 Forest Avenue, Marlboro, Mass. 01752. We are an equal opportunity employer.

RCA
COMPUTERS

Of Hearts, Minds, and Systems

Bioengineering: A Field Led by a Pacemaker

Engineering in the Heart and Blood Vessels
George H. Myers and Victor Parsonnet
Wiley-Interscience, 1969, 198 pp., $14.95

Reviewed by
Ascher H. Shapiro
Ford Professor of Engineering and
Head of the Department of Mechanical
Engineering, M.I.T.

What has come to be called "biomedical engineering" is a field—more accurately a wide range of activities—that conjures up an exciting sense of great expectations. While there is already a large amount of biomedical engineering effort, we are witnessing right now an enormous rate of acceleration of such effort.

The conviction is growing that the traditional education of physicians and medical researchers fails to recognize the importance to medicine of applied physics, engineering science, and the quantitative methods of applied mathematics. Not that the nature of those collaborative activities called biomedical engineering is clearly understood even now: only dimly perceived is the fact that engineers can contribute to medicine not only their specific skills and knowledge but just as much their way of thought and style of attack on problems, a style foreign to the medical profession. Too often one senses the attitude "ring once for the janitor, twice for the plumber, and three times for the bioengineer."

The potential of engineering in medicine will be fully realized only when the spirit of their collaboration is seen as engineers *doing* medical research and development, not merely *helping* medical colleagues, and when the engineer has equal responsibility with his medical colleague in deciding *what* direction of research is most fruitfully pursued.

All this would come about automatically if individuals could acquire education *and* experience in *both* engineering and medicine. Such a marathon accomplishment will be rare. At the least—and this is quite feasible—M.D.'s and engineers must learn something about each other's businesses. Strong moves in this direction are now visible. In increasing numbers, universities are establishing programs intended to couple the educational and research activities of their Schools of Engineering and their Schools of Medicine and to find new modes of training. Research units in hospitals are working with engineers from universities and industrial firms.

There already is a substantial journal literature on these growing activities in biomedical engineering, and symposia proceedings are published regularly. So far, little is available in the form of monographs and textbooks, but many such are sure to come.

The book by Myers and Parsonnet is the second in the Wiley Interscience Series on Biomedical Engineering. To quote from the preface, it "is devoted to the technological, device-oriented aspects of artificial internal organs in the human cardiovascular system. . . . The principal devices discussed are the pacemakers, the artificial heart, heart valves, and vascular prostheses. . . . First, there is a description of the pertinent physiology of the 'natural' human organ. . . . Second, there is a summary of the basic operating principles of the most important of the devices of the class. . . . Third, there is a review of the materials used in the implanted devices, in which particular attention is given to their properties in a biological environment."

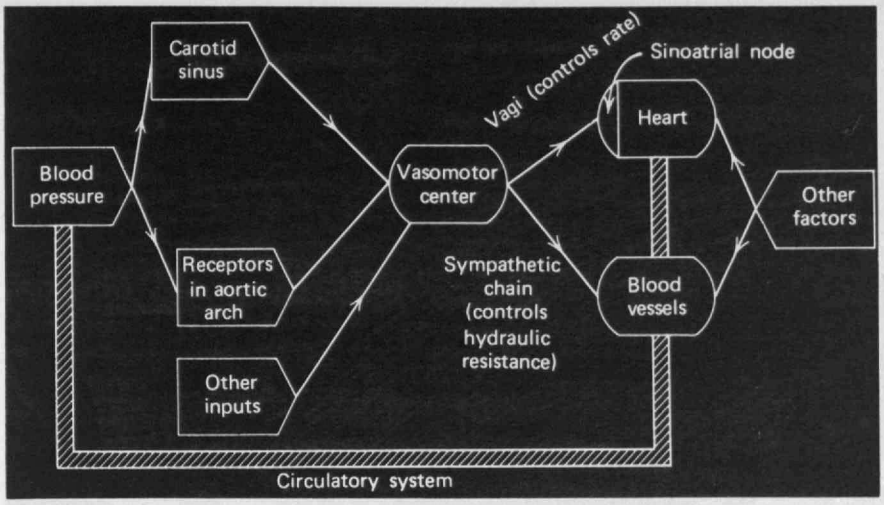
The first chapter, "Artificial Internal Organs" is a very brief survey which quickly goes to the one subject covered in depth in the book: those active prostheses falling into the category of pacemakers (the cardiac pacemaker, the carotid-sinus stimulator, the bladder stimulator, etc.), as against passive prostheses such as arterial and bone replacements. "The cardiac pacemaker is presently the most important of the various types of internal stimulators, . . . and is given the greatest amount of attention. . . . It will serve as a model, both electronically and physiologically, for many other types of devices."

Chapters Two through Seven—"Physiology of Cardiac Rate Control," "Blood Pressure Regulation," "Principles of Operation of Pacemakers," "Theoretical Prediction of Pacemaker Stimulus Thresholds," "Pacemaker Electrodes," and "Clinical Use of Implanted Pacemakers"—are in pursuit of the theme of treating the cardiac pacemaker as a model for a variety of stimulator devices. These chapters reflect a marriage of physiology and medicine and show the confidence of the authors in this part of their subject. The engineer will recognize the systematic and analytical application of the principles of electrochemistry and electrical circuit theory to the understanding and design of pacemakers, and there are many practical details based on experience in physiology and clinical medicine.

These chapters are supplemented by the three short appendices of the book. "Electronic Circuit Elements" is very elementary and is directed toward the M.D. alone. "Additional Proofs" amplifies for the engineer a theoretical treatment in Chapter Two, perhaps for the sake of not discouraging the M.D. reader of the main text. "The Electrocardiogram" is very brief and for the engineer alone.

The remaining chapters are a mixed bag, treated in a very different style: Eight, "Materials in the Body;" Nine, "The Heart as a Pump;" Ten, "Artificial Hearts and Assisted Circulation;" Eleven, "Passive Implants;" and Twelve, "Other Energy Sources." Presumably they justify the book's title. They are almost purely descriptive, generally superficial, and betray the fact that the expertise of the authors is not in these topics. In contrast to the quantitative treatment of pacemakers, for instance, and despite the book's title, one would imagine from the second half of the book that there is a total void in our quantitative knowledge of the mechanics and fluid mechanics of the cardiovascular system.

One of the authors has his roots in electrical engineering, the other in medicine and surgery. Their combination of knowledge is visible in the first half of the book. Perhaps they should have quit after Chapter Seven and given the book a different title. Or perhaps other authors should have been enlisted to make the last half of the book more complete and authoritative.



The natural control system which governs the heart's own "pacemaker" (the sino-atrial node) and the blood vessels, as diagrammed by the authors of Engineering in the Heart and Blood Vessels. *The system offers a variety of possibilities for artificial stimulation.*

Cleaner Water for Cities

Urban Planning Aspects of Water Pollution Control
by Sigurd Grava
Columbia University Press, New York,
223 pages, $7.50

Reviewed by David H. Marks
Assistant Professor of Civil Engineering, M.I.T.

The problems of the control of pollution in the environment have become increasingly noticeable, and the clamor for a reversal of the degradation of our air and water resources has reached an almost feverish pitch. Yet managing resources so as to avoid unwanted pollution levels is difficult because it involves not only technical questions such as what type of processes to construct but complex social administrative, political, and economic issues as well. How much of our limited public resources should be devoted to the quality of the environment, and how should such programs be instituted? Is the dividing-line between pollution and non-pollution a specific number that is inviolable, or is it a function of the perception of the individual and the type of use he is making of the resource?

The main factor dividing the different types of professions involved in the study of such problems is that of scope and scale. The environmental engineers have for the most part been involved in the technical aspects of the problem with only recent recognition of the broader questions involved in management. The urban planners have been at the other end of the spectrum, involved in looking at broad scale plans for cities and regions, and only recently have come to realize that environmental pollution control is not only a component but an extremely important aspect in their planning exercise. In general, they have little or no feeling for the important issues and technical processes involved in pollution control.

It is to an audience of such urban planners that Professor Grava has addressed this book. Its stated purpose is to educate the planner, and it is pleasing to state that the book achieves this goal with clarity, brevity, and insight. Early chapters cover a broad scale exposition of the problem; a short review of some of the regional systems analysis techniques; and descriptive material on pollution sources, types, and treatment considerations. Administrative, regulatory, and financial aspects as well as planning for developing countries are also presented. On the whole, the book is a clear, objective survey in fairly easy-to-understand terms. It resists the temptations to champion some particular cause or to cloud the text with unnecessary jargon. Detailed specifications for sewer networks, water quality levels, treatment plants, and other more mundane technical matters are presented in appendices and are quite complete. A great many references are conscientiously noted, most of which are good but a few of which are not. The author also includes at the end of each chapter suggested research topics.

Overall, this is a good book not only for its intended audience, the urban planner, but for anyone with some scientific background who wishes to become more conversant with the specific issues involved in pollution control. It would make an excellent reference book, for instance, for introducing both engineering and non-engineering undergraduates to these topics. Even professionals working in pollution control, such as this reviewer, would do well to reread it once in a while to remind themselves of the broad scope of their problem area.

Laws of Planning?

The Human Side of Planning: Tool or Tyrant?
David W. Ewing
New York, Macmillan Co., 216 pp., $5.95

Reviewed by
Zenon S. Zannetos
Professor Management, M.I.T.

The title of David Ewing's *The Human Side of Planning* is reminiscent of the late MacGregor's classic, *The Human Side of Enterprise,* which author Ewing says "helped suggest a focus" for his own book. In this regard, *The Human Side of Planning* attempts to deal "primarily with people's efforts within a productive organization . . . rather than with, say, the human factor in the market place or in public relations."

The book opens with an eloquent argument for planning. Among its benefits the author includes opportunities for proper evaluation, control, dynamic goal formation, and fostering healthy cooperation among various individuals and groups within an organization. In Chapter Two one finds some examples of the difficulties involved in planning, along with the claim that between 50 and 80 per cent of all planning efforts have been doomed to failure. The author ends on an optimistic note, however, because (a) people learn, (b) there are evidences of successful planning under conditions no less difficult than those which led to failure, and (c) the factors which influence success are within the control of managers.

Planning goes wrong, according to the author, mainly because it neglects the "people" aspects. Among the dimensions of this problem he includes: (a) an obsession of planners with "bloodless criteria" of efficiency, (b) "other-directedness" (i.e. failure to look first into the capabilities of the people and plan how best to use them rather than make plans on the basis of external factors), and (c) the "fallacy that the future could be blueprinted."

The arguments presented in support of the above points show some logical weaknesses and a superficiality which causes the author difficulties. One could, for example, explain the planning disasters listed (Seagram and "petrochemicals") in terms of failure to analyze properly the *external* environment.

Similar difficulties appear to confront the author in Chapter Four where he discusses the reasons why planning is relegated to operations. He evidently wishes to say that planning is not tantamount to scheduling and that the former harbors more uncertainties than the latter. Instead he implies that even if it were feasible one should not try to blueprint anything, because this is inherently wrong. It may not be wrong, yet it is true that predetermined solutions can stultify the sequential learning and adaptation which should occur.

Humor of a type believed to be employed by the otherwise respectable British weekly New Scientist. *(Photo: N.A.S.A.; the gorilla, product of a local taxidermist, is the mission mascot of Apollo 12, whose crew is in the foreground.)*

Chapter Five is devoted to the individual's needs and their impact on planning. Make the program saleable, the author advises, "by so tailoring it and revising it during the architectural stage that it has the kind of content and substance that will command the support of key individuals." He further recommends "on-the-scene persuasion and demonstration."

This pattern continues throughout the book; the author has a flair for generalities, clichés, repetition, and anecdotes. Some examples: "the informal group . . . rarely reacts in a completely neutral way to a program. For all practical purposes, it will exert either a plus or a minus effect," or, "a potent group may be catalyzed by the program itself," or, "the informal group generally has a conservative influence on planning."

In "The Art of Relating Goals to People," the author suggests internal environmental analysis (strengths, talents, abilities) before looking into the market for opportunities. This is yet a further elaboration on the theme of "other-directedness" introduced earlier.

As to implementation, author Ewing suggests that the "support and enthusiasm" of the people be enlisted. This will require the right choice of time, place, decisions, supervisory styles, size of groups, resources, and communication patterns. He advocates a "total mobilization" where the incentives are integrated with the (time) pressures.

The author devotes a full chapter to the case of a container manufacturing firm which breaks all the rules of good management (low salaries, understaffed, overworked employees, etc.), yet "gets away with its unorthodoxy despite the fact that it has large, powerful, and well-known competitors." The moral is that the firm's "total mobilization" is behind its success; it is able "to serve customers quickly and efficiently and to move quickly when a new opportunity appears."

As to the role of the leaders of planning, the author advocates a deep personal involvement in the process of setting objectives and evaluating performance.

Furthermore, this type of involvement, says the author, should start with the chief executive who must manage his working days to have uninterrupted periods of time devoted to planning. Another characteristic of Ewing's leader is that he employs "aggressive communication;" this is the "nuts and bolts" part of the planner's business.

Unfortunately the author's grasp of planning is fleeting. He tends, for example, to equate such activity with innovation and "rapid adaptability to change." The reader may legitimately wonder as to whether *central* planning which is accompanied by aggressive communication can be so classified.

Chapter 13 deals with some "do's and don't's" for gaining political power, mostly borrowed from *McMurry's Management Clinic,* and Jay's *Management and Machiavelli.* Some illustrative quotes are: "try to make yourself indispensable to nonplanners," "sometimes you will have to be ruthless," and "communicate selectively."

Ewing then discusses how to develop effective organizations for planning. Like most of the chapters of this book, it is compartmentalized, diffused, and superficial. Absent are some of the fundamental issues affecting centralization and decentralization. The examples of actions taken "to assure that innovators and innovations in the organization do get proper support," and the discussion of the examples, neglect the influence of critical task characteristics such as those reflected in economies of specialization and in complementarities versus substitutabilities of resources and operations.

The author concludes his discussion with a summary of the points he makes in the book under the rather bold title of "Some Laws of Planning." The reader is well advised to look at the concluding chapter first before he invests time in going over the whole book.

Those who happen to read this review will have realized by now the disappointment of this reviewer. Attracted by an inviting title and introduction, one opens the book with high expectations, especially since the author appears to use as a standard *The Human Side of Enterprise.* Unfortunately the similarities between the two volumes do not go much beyond the titles. Ewing presents an array of thoughts and anecdotes which are not bound together by any cohesive philosophy, theory, or set of hypotheses. The scientific and logical tools of inference, search, and validation are not exploited. The many "examples" which are presented do not form a series of empirical observations amenable to generalization. In fact the reader often wonders whether the author molds the discussion to fit the anecdotes rather than use the latter as illustrations of fully thought out "laws of planning."

It Seems There Was This Worm-Runner . . .

The Science of Humour, the Humour of Science
(Special Issue of *Impact of Science on Society*)
Bruno Friedman, Ed.
Paris, UNESCO, 80 pp., $1.00

Reviewed by
Fred Wheeler

On the principle that in the country of the blind the one-eyed man is king, in a really neglected field a special issue of a periodical can rate a book-review, without the risk of setting precedents.

It is a sad reflection on these melancholy times that Mr. Friedman has to spend two pages justifying himself. He was told that he was wasting space in "a serious magazine." The nub of his reply is that "humour has the task of restoring perspective on any human activity, institution or being whose image becomes overblown or distorted . . .

Humour is, as our authors repeatedly affirm, a most serious business, not only for coping with science, but for coping with life itself."

The danger of overblowing the image of humor itself is not entirely avoided. There could have been more of the humor of science and less of the science of humor, since the latter is, after all, a singularly unproductive discipline. Nobody seems to know why we laugh; this much becomes abundantly clear in the many "science of humor" articles. Sure enough, chimpanzees laugh at their own crude practical jokes, but there is little in this to account for, say, Dr. Gell-Mann's innovations in scientific nomenclature. Like God, laughter is good and mysterious, and anything else you say about it is liable to be wrong.

Fortunately, the learned humorologists are nicely deflated by László Feleki, of the Hungarian satirical weekly *Ludas Matyi.* Reasoning in true academic style, he arrives at such conclusions as: "a proper appreciation of scientific humour requires the proper scientific qualifications. This requirement raises highly important questions about education, for, unless we can provide the generations to come with the necessary foundation of knowledge, they won't be able to laugh." The kinds of comedy we have been accustomed to hitherto can clearly not last for ever. In the march of science, humanity will inevitably conquer all its defects—including the malice which leads people laugh at them. "And once human nature lacks pride, vanity, envy, jealousy, pettiness, greed, anger, hatred, selfishness, hypocrisy, capriciousness, impatience, pompousness and sloth, then, indeed, nothing will be left to scorch with the vitriol of satire. A different solution must be found and elsewhere." Perhaps the computer will be as useful here as it is in other fields. Eventually, of course, manned space exploration will get to the point where joke-samples can be brought back from more advanced civilizations than our own.

Those who are left cold by this Hungarian may be interested in the preliminary study of geographical and historical variations in what makes people laugh, by David Victoroff of the University of Caen. On current geographical variations, he cites P. Daninos's *Le Tour du Monde du Rire,* picking out a story showing the Japanese to have no sense of humor whatever. He introduces us to the ritual laughter found in many ancient and some primitive societies. For example, "the initiation ceremonies in the cave of Trophonios at Lebadeia included a ritual peal of laughter at the moment when, after a mock death ceremony, the priests brought the initiate feet first out of the cave and returned him to his friends." Is there, perhaps, something ritual about the American custom of transmitting "canned" laughter along with television comedy shows? How would an English-speaking but non-American anthropologist discover whether *I Love Lucy* was actually funny, in any non-ritual sense?

Then there are the historical changes. Whereas Harry F. Harlow, of the University of Wisconsin, makes much of Freud as a theorist of humor, Mr. Victoroff points out that Freud's attempt at a general explanation was backed up with little but the witticisms of late 19th-century Vienna. (In all fairness, Harlow does cite Freud for a rather good Roman joke: the emperor Marcus Aurelius notices a low-class citizen resembling himself and asks the man if his mother was ever employed as a servant of the emperor. "No, sire, but my father was." We are not told whether it was this crack that caused Aurelius to take up stoicism.)

"Why is the blind man, who used to make medieval audiences laugh, no longer regarded as a figure of fun on the stage, whereas the half-wit still figures prominently in present-day writing? To say that our sensibilities are more refined than those of our ancestors does not seem to get us very far." So, much remains to be done. If we could just understand what makes people laugh who are different from ourselves, who knows, we might be able to travel around the world without appearing ridiculous.

Two things you will find in this collection: the stories of the *Worm-Runner's Digest* and the *Journal of Irreproducible Results,* which are the only two intentionally funny scientific periodicals their editors know. The *Digest,* which its editor James V. McConnell describes as "somewhat humorous, semi-scientific," began as an information manual for high-school students who were interested in doing experiments with flatworms. Like the sorcerer's apprentice (and *there's* a science-joke for you—it first appears, to my knowledge, in one of the satires of Lucian (2nd century) as an example of the sort of thing people will believe these days) Dr. McConnell was astonished to discover that the *Digest* just kept going. Starting with a funny name, it received funny contributions. McConnell now finds that he has sold his reputation for a song. Because he publishes a light-hearted journal, he says, he has had difficulty in getting his flatworm research taken seriously—although it is at least as serious as most research. Dr. McConnell's worm-runner's-eye-view of the world of Science (which is solemn, as distinct from science, which is the honest search for truth by admittedly fallible people) is well worth reading.

The *Journal of Irreproducible Results* is quite deliberately satirical, the subject of the satire being scientific publications. It started in Israel, with a mock-learned discussion of the rate of disappearance of laboratory glassware and is now published in Chicago. The change was the result of increasing demand—*J.I.R.* now has 20,000 subscribers. It is described here by Alexander Kohn, its founder and chief editor. Some may find Kohn's humor lacking in subtlety, but one cannot argue with success.

Ground floor EDP opportunities

at Raytheon's new Data Center, Andover, Mass.

Raytheon is opening a new Data Center in Andover, Mass. It will be operated by Raytheon's Bedford Laboratories — a leading R & D facility.

If you are familiar with the IBM 360-65 series and like working on systems from their conception, check these career positions.

SR. INFORMATION SYSTEMS ANALYSTS
Will conduct major multi-functional systems studies including: determination of data elements, analysis of the information processing requirement, and projected solution to the problem. The successful applicant will be applying the latest techniques in the design and implementation of large, multi-functional, information management systems and by this effort will be directly contributing to the formulation of new methodology to meet rapidly expanding objectives in data processing.

SR. INFORMATION SYSTEMS PROGRAMMERS
Will analyze and evaluate interrelated data processing requirements to recommend the method and feasibility of computer application. Designs, in conjunction with other programmers, systems analysts and department representatives, the most efficient and economical computer system. Executes or directs all phases of electronic data processing programming. Will also develop general purpose computer routines utilizing computer manufacturers software.

SYSTEMS PROGRAMMERS
Programmers for remote job entry and real-time applications for a broad spectrum of financial, manufacturing, and engineering problems.

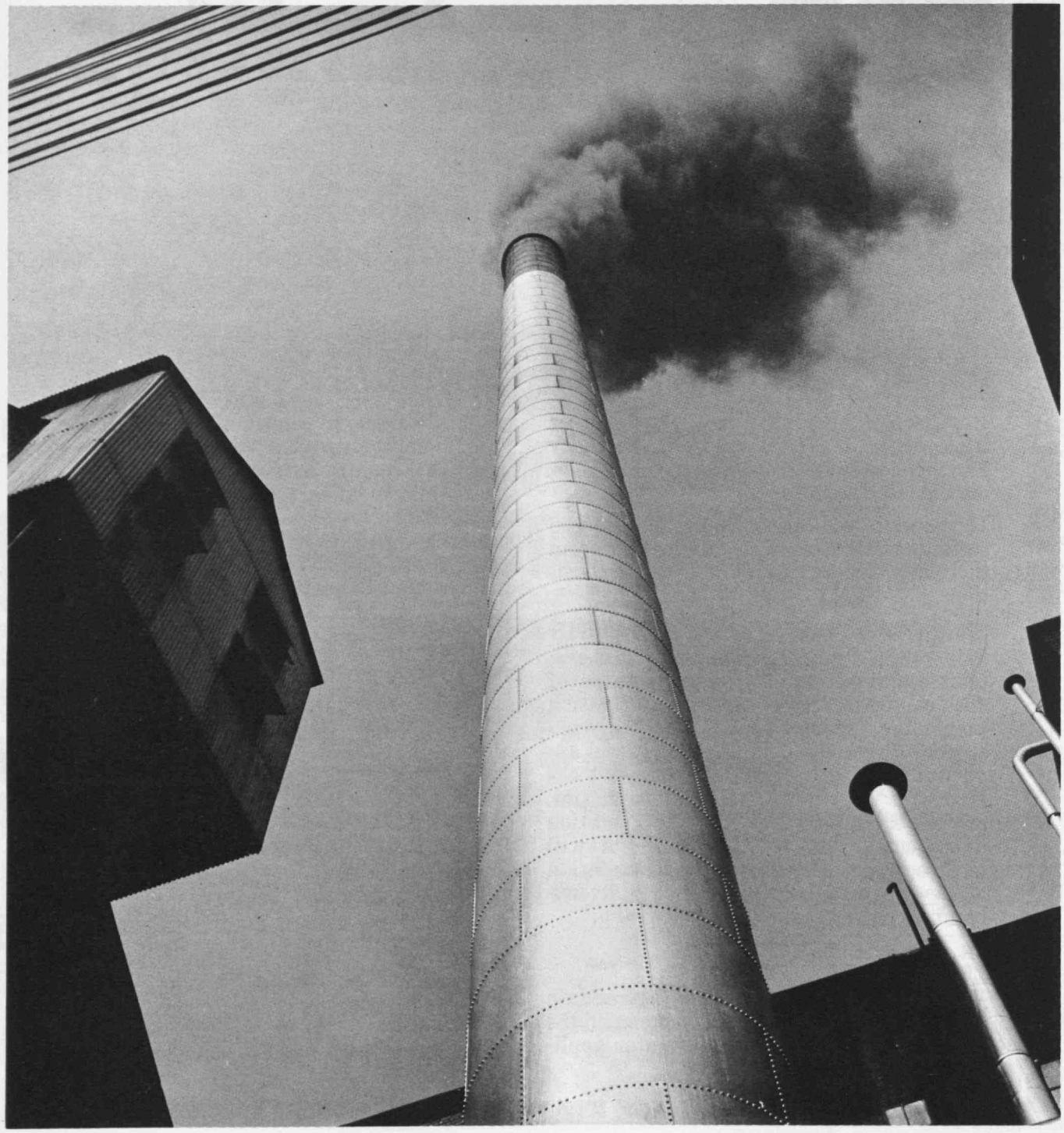
The above positions require from two to four years experience in programming with the 360 series. Experience in lieu of a formal degree acceptable. Background in manufacturing or accounting desirable.

To arrange your interview, call or send your resume including salary history to Anthony J. Bertolino, Bedford Laboratories, Dept. 219, Raytheon Company, Bedford, Mass. 01730. Tel.: (617) 274-7100, Ext. 2136.

An equal opportunity employer

RAYTHEON

Over 60 per cent of the 44 million tons of sulfur dioxide discharged into the atmosphere in the U.S. this year will come from coal- and oil-fired power plants. By the year 2000, when total emissions will have increased to nearly 120 million tons, over 80 per cent (97 million tons) will result from power generation. (Photo: Ewing Galloway)



The sulfur oxides are a major health hazard in air pollution. But our supplies of low-sulfur fuel are few and our technology for sulfur removal is inadequate to give us comfort

Thomas K. Sherwood
Professor of Chemical Engineering, Emeritus
M.I.T.

Must We Breathe Sulfur Oxides?

The control of our deteriorating environment has become a national goal of high priority. Many Americans are increasingly alarmed by our pollution of air and water and concerned about noise and about solid waste disposal. Increasingly stringent control legislation is being proposed by Congress and by the states. College students—especially in engineering—want to use their education to tackle these problems. A recent newspaper poll placed pollution control fourth on a list of national priorities. Government and industry are spending hundreds of millions of dollars annually in efforts to understand and control pollution.

The much-quoted 1967 estimates by the Department of Health, Education and Welfare give the following figures for total discharge, in millions of tons each year, of the atmospheric contaminants of greatest present concern: carbon monoxide, 72; sulfur oxides, 26; nitrogen oxides, 13; hydrocarbons, 19; and particulate matter, 11—a total of 141 million tons per year, or some 140 pounds per year for each acre of the continental U.S.

Impressive as these figures are, they mean little unless each pollutant can be assigned a weighting factor indicating its relative importance as a health hazard and as a source of annoyance. Unfortunately, the medical evidence as to health hazards is incomplete and contradictory, and the extent to which any form of pollution simply annoys people is highly subjective.

Many pollutants are suspected of contributing to the pollution hazard, but health authorities appear to consider sulfur dioxide—and the very unpleasant trioxide by which it is invariably accompanied in small amounts —as the most serious single threat. Though automobiles contribute some 60 per cent of the total mass emissions of air pollutants, the Department of Health, Education and Welfare spends several times as much money on research directed to sulfur oxide control as on work toward abatement of the pollution from auto exhaust.

About 80 per cent of the sulfur oxides discharged into the atmosphere come from the combustion of coal and oil. Gasoline contains almost no sulfur, so emissions from automobiles contribute little. But the combustion of coal, averaging about 2.5 percent sulfur, accounts for more than half the total SO_2. Heavy fuel oil, burned in apartment houses and power plants, contributes quite substantially.

H.E.W. predictions shown in the table (page 30) indicate that total SO_2 pollution may triple in the next thirty years if not controlled more effectively than at present. Nuclear power plants emit no SO_2, but the use of coal for power is increasing steadily and will more than triple by 2000 before leveling off after the turn of the century as large nuclear power stations replace those burning fossil fuels.

The Health Hazards of Sulfur Oxides

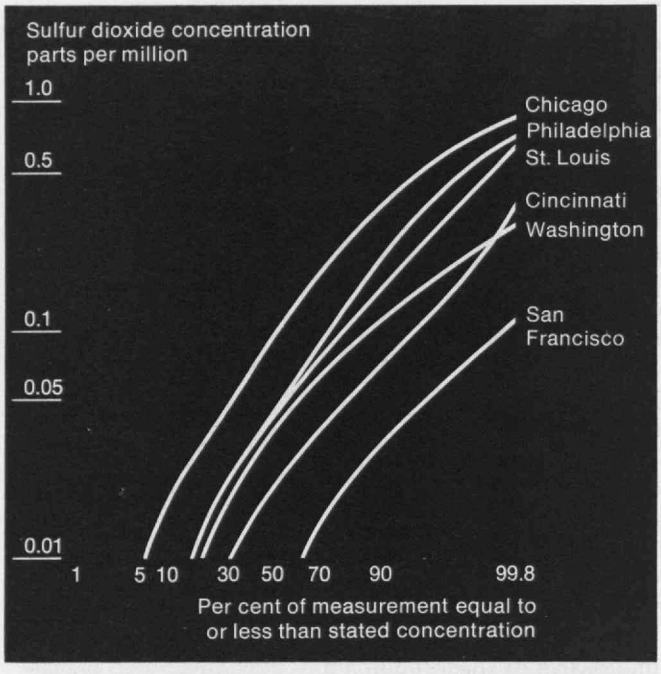
Much of the alarm about the health hazards of sulfur oxides stem from publicity regarding several "episodes" in which people died during periods of heavy air pollution. These occurred in the Meuse Valley in 1930, in Donora, Pa., in 1948, in London in 1952 and 1962, and in New York in 1953 and again in 1966. Some 4,000 more people died in the few days of the London episode in 1952 than would normally have succumbed in a similar period of time. These "excess deaths" are usually blamed on SO_2, though the smog at the time contained many other pollutants.

Congress has asked the Department of Health, Education and Welfare to publish summaries of data on the effects of various individual pollutants on health. These are intended to provide "criteria" which the states and "quality control regions" will use in establishing "standards" of acceptable atmospheric pollution levels. Only criteria for SO_2 and for particulates have been issued to date. Most of the data quoted were obtained in laboratory experiments with animals; there have been few clinical studies on man with SO_2 concentrations typical of polluted city air. The first publication on SO_2 in 1967 was widely criticized on the grounds that the research studies cited as justification for the criteria were "frequently vague, incomplete, or quoted out of context." The second publication on SO_2 standards, in 1969, repeated the earlier conclusion that ambient SO_2 concentrations of more than 0.1 p.p.m. for 24 hours in any consecutive 100-day period may produce adverse health effects in particular segments of the population.

Without control measures, most coals now burned in power plants would cause this concentration to be exceeded in large cities. (The maximum average 8-hour concentration reported for U.S. cities is 1.5 ppm, in New York).

The evidence regarding SO_2 (or almost any other pollu-

Concentrations of sulfur oxides in the atmosphere in the U.S. range up to 3.2 p.p.m., the higher figures appearing in commercial and industrial sections of solid-fuel-using cities. The chart shows a frequency distribution of sulfur oxide data for six American cities. (Chart: Arthur C. Stern, Air Pollution)



tant) is highly confusing, but one conclusion appears valid. It is that people with bronchitis, emphysema, or lung cancer are highly susceptible to prolonged exposure to SO_2—or to generally polluted city air which always contains SO_2.

As Dr. William H. Stewart, Surgeon-General, told Senator Edmund S. Muskie's committee in 1967, "It is rarely possible . . . to point to an individual case and say with certainty, 'This man died because of air pollution.' " And Dr. P. J. Lawther, a leading British authority, has stated that "experimental exposures to SO_2 or sulfuric acid in the kind of concentrations which may be found in towns have never resulted in significant or consistently reproducible increases in airway resistance in human subjects." Yet Dr. Stewart has shown convincing evidence that SO_2 seriously affects people with respiratory diseases, though the possibility that it may cause such diseases is not proved. Dr. Lawther, referring to the increased death rates during periods of heavy air pollution, confirms this evidence: "The excess deaths are among the old and the frail, the newborn, and those suffering from diseases of the respiratory and cardiovascular system." That the old and weak are more susceptible is supported by the fact that the SO_2 standard set by the American Conference of Governmental and Industrial Hygienists is 5 p.p.m. for an eight-hour exposure by healthy industrial workers.

Much has been made of the probable health hazards in presenting the case for SO_2 control. But there are additional reasons to limit pollution, perhaps even more persuasive. One is the damage it does to property and plants. Another is the fact that people *just don't like polluted air.* This last is really a pretty good reason, since pollution annoys almost everyone. In the modern U.S. economy we can afford to get rid of serious nuisances, and we are (erroneously) believed to have the technology to control SO_2.

Demoting pollution to a serious nuisance, however, would demote its control to a lower position on the list of national priorities than if it could be shown that New York was about to become a large-scale Donora.

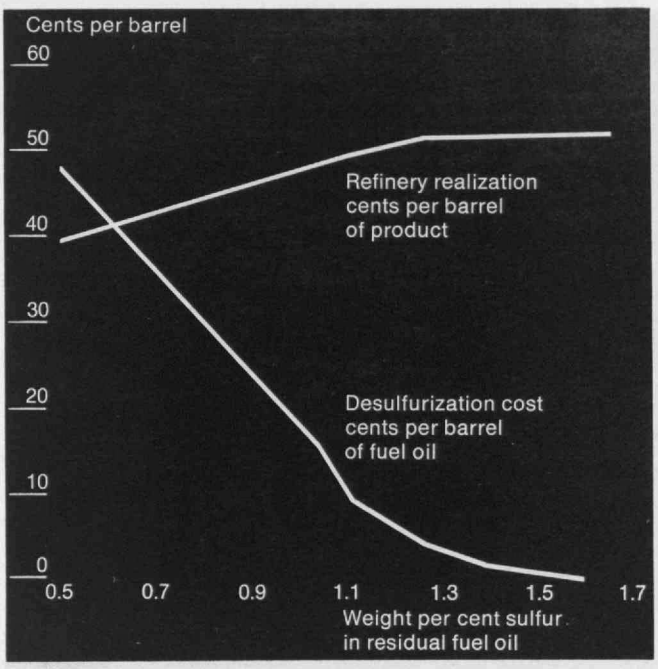
Though a great deal of clinical research is needed to clarify the impact of pollution on health, H.E.W. is convinced, as Dr. Stewart has stated, that "it would be foolish to say that we do not need more research. . . . It would be equally foolish and much more dangerous to suggest that we must wait for more knowledge before we begin to control pollution. We can, and we must, proceed now," he insists. In any case, both Congress and the public and the public are aroused, and the country is committed to action.

Limiting the Sulfur Content of Fuel

The obvious way to reduce air pollution by sulfur oxides is to limit the sulfur content of the fuels burned. About 60 per cent of the total SO_2 discharged into the atmosphere comes from the burning of coal; of this 80 per cent is emitted from power plants. The relation between the SO_2 concentration in the atmosphere to that in the coal varies with meteorological conditions and topography, but it is estimated that the standards suggested by H.E.W.'s criteria would be met if the coal burned were limited to 1.0 per cent sulfur, or substantially less in some large cities.

The New York-New Jersey Metropolitan Area has set standards requiring a maximum of 1.0 per cent sulfur for fuels burned in existing power plants, and other regions are following suit. Bituminous coal containing more than 1.0 per cent sulfur cannot now be sold in New Jersey, and the limit will drop to 0.3 per cent in 1971. But the

To reduce the sulfur content of residual fuel oil—the product commonly used for power generation—is within the power of present-day technology. But the cost is so high that it represents an increase in basic fuel cost of 20 to 35 per cent. At 50 cents per barrel of oil, desulfurization is adding 0.7 mills per kwh. to the cost of power. (Data: Chemical Engineering Progress)



supply of low-sulfur coal and oil is limited, and it appears impossible to provide the needed fuels if this standard were to be enforced across the country.

Half the U.S. coal reserves are east of the Mississippi and half west. But 90 per cent of the low-sulfur coal reserve, much of it low-grade, is in the west, remote from the large eastern markets. The low-sulfur coal produced in the east amounted to but 34 per cent of the coal mined in 1964. Approximately one-quarter of our low-sulfur coal is in fact exported, and much of the rest of it is sold at a premium for metallurgical use. Consolidated Edison (New York) is reported to have entered into a long-term contract to purchase low-sulfur coal at $1.50 per ton more than its usual price in the past.

The dilemma is apparent. If all fuels were to be limited to 1.0 per cent sulfur in order to control air pollution, there would simply not be enough coal to meet the growing demand for power, and much of the coal industry would be put out of business. We must control sulfur emissions, and we must have the power. The situation is like that of an irresistible force and an immovable object.

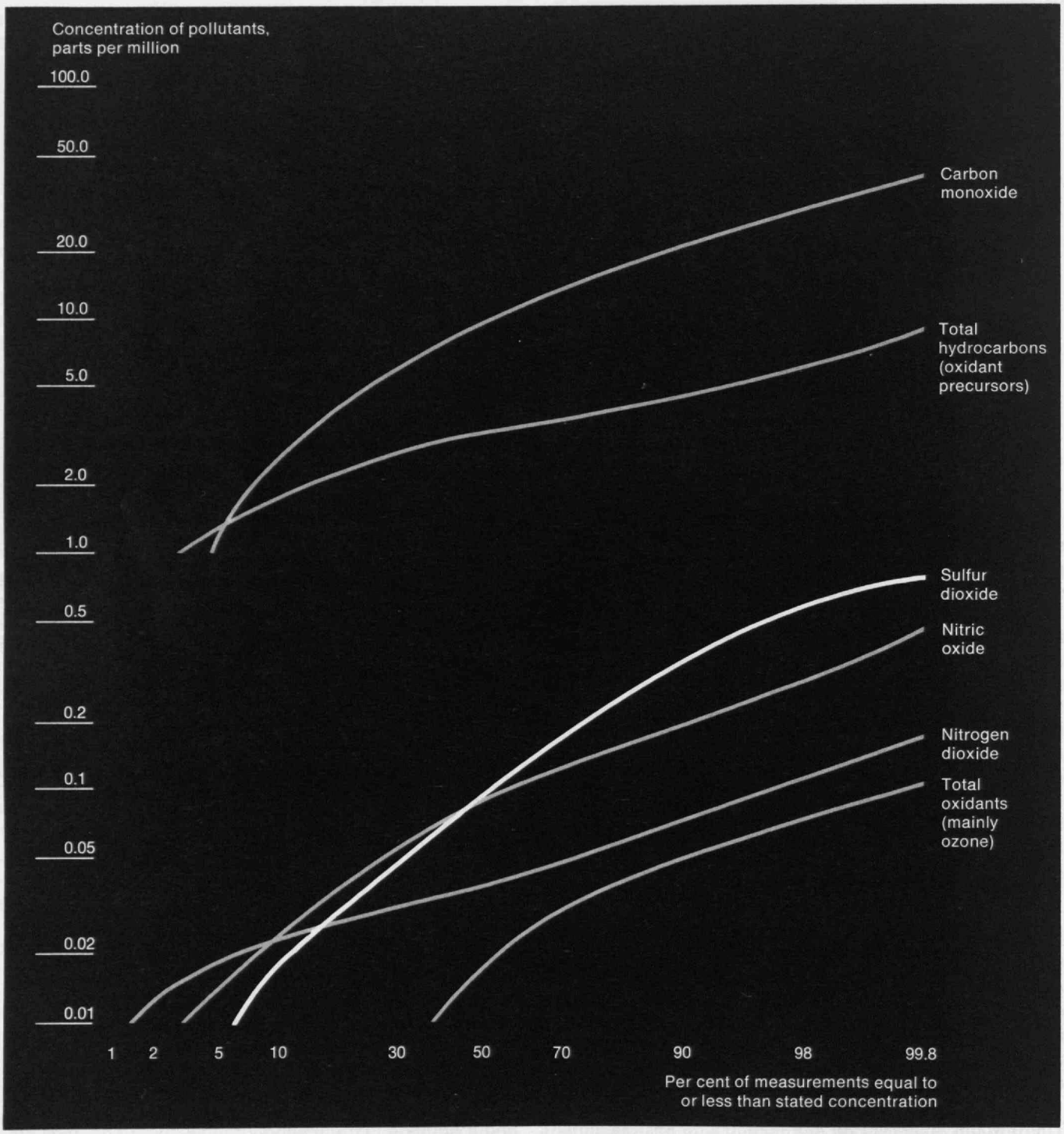
There would appear to be four solutions to this dilemma: undertake a massive program to quickly build nuclear power plants; remove sulfur from fuels before they are burned; remove the SO_2 from the combustion gases before emission to the atmosphere; and employ very high stacks or other means to deliver the gases at such a high elevation that they are dispersed and diluted to an acceptable level before they reach the ground. New power plants can be located in sparsely-populated regions.

The first approach is impractical because of the prohibitive expense. Tall stacks are being promoted in England but appear to have limited applicability. The second and third approaches offer the best promise in the U.S. The processes to accomplish sulfur removal from fuels and combustion gases are not fully developed, however, and not immediately available for wide application.

Sulfur is readily removed from distillate oils and the technology is well established. Residual fuel oils are more difficult to treat because they contain metals which deposit on the solid catalysts employed. The petroleum industry has spent a very large amount of money on the development of ways to desulfurize "resid," however, and there is no doubt that these schemes will work. Esso, for example is now installing desulfurization units in Venezuela to produce 100,000 barrels per day of low-sulfur residual fuel oil primarily for U.S. east-coast power plant use. The investments required in such plants are enormous, and the added refining step to reduce the sulfur content from 2.6 to 0.5 per cent will apparently increase the price of residual fuel to the power station by 50 to 80 cents per barrel (assuming a five-year pay-out)—an increase in fuel cost of 20 to 35 per cent. Fifty cents per barrel of oil is equivalent to an increase of about 0.7 mills per kwh. in power costs.

Coal is quite another matter. The sulfur is present both as pyrite and as complex organic substances. The first can be largely removed by grinding and washing, using existing technology. No one seems to have a good idea as to how the organic sulfur might be removed, except by expensive hydrogenation and liquefaction processes. The two forms of sulfur exist in coals in widely varying ratios, and segregation of those readily washed to remove pyrites is difficult. The National Air Pollution Control Administration is actively studying the problem, and it appears that the supply of low-sulfur coal may be

The sulfur oxides are not—by far—the grossest polluters of our urban air. But many health authorities consider them the most serious single threat. The curves show the amounts (in parts per million) of various pollutants in the atmosphere of Chicago, Ill., during the period 1962 to 1964, as published by the U.S. Public Health Service in 1966 (Data: Arthur C. Stern, Air Pollution)



increased appreciably by wet cleaning methods. Preliminary results suggest that perhaps 15 to 20 per cent of the high-sulfur utility coal is washable to 1.0 percent sulfur at an incremental cost of 25 to 75 cents per ton.

Where fuel desulfurization is practical at reasonable cost it offers the most obvious and direct method to reduce SO_2 pollution from combustion. Though they are not yet economically attractive, there are several processes under development for the production of liquid fuels from coal, and these will perhaps be employed commercially within a decade. In the meantime most of the needed coal cannot be adequately desulfurized at acceptable costs.

Controlling Power Plant Emissions

This leaves us with the third of the solutions to the dilemma: burn high-sulfur fuels, but remove the sulfur from the stack gas. Many ways of doing this are being actively developed at the moment. All involve some means of bringing the gas in contact with some substance which picks up SO_2, leaving the gas going to the stack relatively free of this pollutant. There are some 25 such processes under development in this country by industry and by the National Air Pollution Control Administration (N.A.P.C.A.), and many others are being developed in Japan and Europe. Most are small-scale laboratory projects, but several have reached the pilot-plant stage. Only one has been installed in sizable operating power plants.

Several of these processes will doubtless turn out to be technical successes, but the economics are not yet well established for even the most advanced. Contrary to a widely held belief, the technology does not in fact now exist to effectively control SO_2 emissions, and it is coming along too late to prevent a very substantial increase in SO_2 pollution levels during the next ten to fifteen years.

The limestone injection process uses limestone in two ways. Powdered limestone blown into the combustion chamber picks up some of the SO_2. The gas is then cooled and scrubbed with an aqueous suspension of lime or limestone to remove the solid particles of sulfite and sulfate, fly ash, and most of the remaining sulfur oxides. It is then reheated to maintain plume buoyancy leaving the stack. The scrubber is necessary because less than half of the sulfur is picked up by the powdered limestone in the combustion chamber. The total solids to be disposed of amount to nearly three times the normal fly ash from a coal containing 10 per cent ash. These solids are essentially worthless and present something of a disposal problem—for example, 160,000 tons per year for a 200-MW. power plant.

The lime-scrubbing process has been installed to treat all of the stack gas from two 125-MW. boilers—one at the Meramec Station of the Union Electric Company in St. Louis, the other at the Lawrence plant of Kansas Power and Light Company. Both plants have had start-up troubles but are expected to meet the design objectives of 82 per cent sulfur removal and 99 per cent removal of particulates.

Though the wet scrubber appears to be necessary because of the low SO_2 removal in the combustion chamber, the possibility remains that dry limestone injection alone, with no scrubber, can be developed to remove sufficient SO_2 to be useful with many coals. This simpler and cheaper version of the limestone process is being tested in a 150-MW. boiler at the Tennessee Valley Authority under a contract with N.A.P.C.A.

Several processes employ aqueous solutions of substances which react chemically with SO_2 and remove it from the gas. The chemical agents must be regenerated and reused, since they are relatively expensive. These processes usually require a high-efficiency electrostatic fly-ash eliminator, an absorber in which the gas comes into contact with the solution, a mist eliminator, and, in most wet scrubbing processes, some provision for reheat of the gas going to the stack.

The regeneration of the solution liberates the absorbed sulfur, normally as SO_2. This can be sold as such, or it may be converted to sulfuric acid or to sulfur. Sale of these by-products can conceivably offset the cost of the entire operation. One process regenerates the solution with steam, another by electrochemical methods. Most schemes of this type involve the addition of a chemical plant of considerable size to the power-generating facility.

A variation of the aqueous solution schemes is the use of a molten mixture of inorganic carbonates. This mixture has a high capacity to absorb SO_2 chemically, and the circulation rate is small. The sulfites and sulfates are

converted to sulfides, which are treated with reducing gas to yield hydrogen sulfide. The product gas is suitable as the feed to a Claus plant for the production of salable sulfur. The stack gases contact the molten salt at 800° F. in a simple spray device, and no reheat is required. Only laboratory bench-scale studies have been made.

Sulfur oxides can be absorbed chemically by various dry solids, including several metal oxides. The finely divided or pelleted material contacts the gas in a packed or fluidized bed or in some form of "raining solids" device. It is then regenerated by use of a reducing gas. The SO_2 ends up as marketable sulfur. Processes of this type have received something of a set-back because of recent difficulties with the Bureau of Mines "alkalized alumina" process. The solid reacting agent was found to be insufficiently stable, physically or chemically, to last through the large number of cycles of absorption and regeneration required to make the process economically attractive.

Solid carbon in the form of inexpensive char has been used in Germany to pick up SO_2 from stack gas. A related process using activated carbon has been operated in a fair-sized pilot plant in this country. The carbon contacting the gases at 300° F. in a fluidized bed acts as a catalyst to produce sulfuric acid, which is held by the carbon. The acid is removed from the carbon by chemical methods and the carbon is recycled. No gas reheat is required, and marketable SO_2, sulfuric acid, or elemental sulfur can be produced.

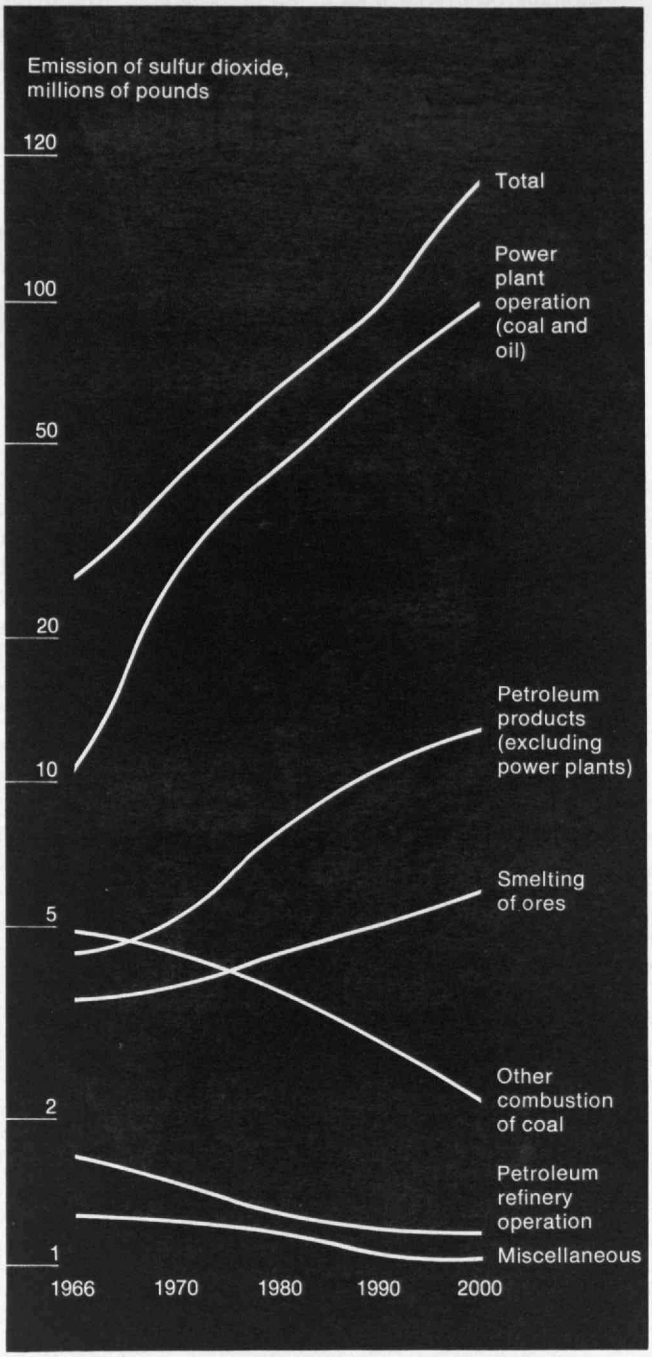
One final example will illustrate the varieties of the processes being developed for SO_2 control from stationary sources. This is the catalytic oxidation process, now well developed, based on the well-known technology of sulfuric acid manufacture. The gases pass from the boiler to an efficient high-temperature electrostatic precipitator and then to a bed of solid catalyst which converts SO_2 to SO_3. The latter is absorbed in weak acid to produce 70-80-weight-per-cent sulfuric acid. This contains a trace of fly ash, but is directly useful in the manufacture of fertilizers, the principal market for this acid in the U.S.

These examples illustrate the diversity of the stack-gas treatment processes being developed. One type produces a "throw-away" product; the others will yield SO_2 (with a very limited market), sulfuric acid (with a market limited by shipping costs), or elemental sulfur, which is easily stored and shipped. The total sulfur effluent of all utilities would now supply more than half the U.S. sulfur market.

As noted above, none of the stack-gas cleaning processes has been operated in a large power plant for more than a few weeks. Costs, therefore, are highly speculative. The less advanced the development, the lower the estimated costs. Cost estimates range from zero to one

	Annual emission of sulfur dioxide (millions of tons)				
	1966	1970	1980	1990	2000
Power plant operation (coal and oil)	13.0	28.0	42.0	60.0	97.0
Other combustion of coal	4.7	4.3	3.5	2.9	2.5
Combustion of petroleum products (excluding power plant oil)	4.4	5.3	7.1	9.6	12.7
Smelting of ores	3.5	3.7	4.1	4.5	5.0
Petroleum refinery operation	1.6	1.4	1.2	0.9	0.8
Miscellaneous sources*	1.3	0.9	0.5	0.3	0.2
Total	28.5	43.6	58.4	78.2	118.2

* Includes coke processing, sulfuric acid plants, coal refuse banks, and refuse incineration.



Atmospheric pollution by sulfur oxides will increase as U.S. power consumption increases during the last 30 years of this century. By the year 2000 power plant operation—the major source—will add nearly 100 million tons of sulfur dioxide to the atmosphere unless restrictions more severe—and costly—than any now in effect are applied. Other sources make relatively modest contributions to the sulfur dioxide burden of the atmosphere. (Data: October, 1969, estimates of the National Air Pollution Control Administration)

mill per kwh. If the proven cost turns out to be 0.5 mills per kwh., the annual charge to U.S. electricity consumers would be about $500 million in 1970 and $2 billion in the year 2000. (The investment in facilities at $10/kw. would be some $8 billion by 2000.) These costs, of course, would be added to the bills sent to users of electric power.

The Future of Sulfur Control

The future of sulfur control is not hard to predict, at least in general terms. The country is committed to do something about air pollution, and increasingly stringent standards regarding sulfur concentrations in the ambient air are beginning to be enforced. Users of high-sulfur fuels will turn first to natural gas, desulfurized fuels oils, and the limited supplies of low-sulfur coals. These will command a premium over present fuels, and the coal industry will find washing of steam coals profitable.

These developments, however, will not provide the total requirements of low-sulfur fuels necessary to control increasing sulfur emissions, so many utilities will install facilities to remove sulfur from stack gases. By 1975 there should be several proven processes to do this. The simpler methods which produce "throw-away" by-products will be adopted by many existing plants. The more complicated processes which produce acid or elemental sulfur will be incorporated primarily in large new steam power plants.

By perhaps 1980 or 1985 sulfur emissions stemming from smelters and the combustion of fossil fuels will be under fairly good control, though total sulfur emissions will have risen substantially over those at the present time. By 1985 or 1990 there may be better ways to burn coal, as by fluidized-bed comustion in the presence of lime, which both improves boiler efficiency and eliminates sulfur from the stack gases. By 2000 the sulfur problem will be greatly lessened by the substantial switch to nuclear power.

All of this will cost a great deal of money—perhaps $500 million to $2 billion per year. But this would seem to be no great price to pay for removing a threat to health and making the U.S. a better place in which to live.

Thomas K. Sherwood, a native of Canada, has been a member of the M.I.T. faculty in the Department of Chemical Engineering since 1929, when he completed his Sc.D. degree at the Institute. He became Emeritus Professor upon reaching retirement last June, and he will soon take up an academic post at the University of California (Berkeley). This article is drawn, in part, from his experience as a member of the Committee on Air Quality Management of the National Research Council.

The Santa Barbara oil slick as it was in February last year: photograph shows a log-boom in use at the entrance to the harbor (Photo: AP)

The control of marine oil pollution is hampered by inadequate research and by economic constraints, but properly designed legislation could do much to discourage the polluter

James A. Fay
Professor of Mechanical Engineering,
M.I.T.

Oil Spills: The Need for Law and Science

"A new danger, moreover, now threatens the birds at sea. An irreducible residue of crude oil, called by refiners 'slop,' remains in stills after oil distillation, and this is pumped into southbound tankers and emptied far offshore. This wretched pollution floats over large areas, and the birds alight in it and get it on their feathers. They inevitably die. . . . Five years ago, the shores of Monomoy peninsula were strewn with hundreds, even thousands, of dead sea fowl, for the tankers pumped out slop as they were passing the shoals—into the very waters, indeed, on which the birds have lived since time began! To-day oil is more the chance fate of the unfortunate individual. But let us hope that all such pollution will presently end."—Henry Beston in *The Outermost House* (Viking, New York, 1928).

In the forty years since Henry Beston first described what has now become a common occurrence along our ocean shores, we have made little progress in stemming the tide of oil pollution. Indeed, incidents are occurring more frequently and occasionally reach catastrophic proportions.

Before we can reverse this dangerous trend, we must first understand what are the circumstances which give rise to oil pollution and how they came to be. Moreover, before we can hope to devise an integrated plan to secure the abatement of oil pollution, we must also understand the respective contributions that science, technology, and public management can make to the solution of this problem.

Pollution of the sea by crude or refined oils has become a global problem because of the rapid growth of the amount of oil shipped by sea during the past twenty years. Each year more than a billion tons of oil are transported across the oceans, sometimes nearly halfway around the globe (A billion tons of oil, if spread uniformly over the surface of the earth, would form a layer as thick as a sheet of paper). The modern supertanker, a ship ten times as large as its ancestor of only twenty years ago, epitomizes both the growth and the present size of the transoceanic oil transportation system.

In addition to tanker transportation, oil production from offshore wells has grown immensely in the past decade, adding further to the potential for oil pollution. About one-sixth of the world's oil is presently supplied from offshore wells, and it is expected that the amount will increase at least fourfold in the next ten years.

How much oil is spilled into the sea each year? A conservative estimate, based on a spillage rate of 0.01 per cent estimated for the "clean" harbor of Milford Haven, leads to the conclusion that at least 200,000 tons per year of hydrocarbons are introduced into the marine environment. A more realistic estimate of spillage from all sources would be about one million tons per year (the present annual world catch of fish is six million tons). Unless there are improvements in the technology of handling oil at sea, aboard both vessels and drill platforms, the yearly burden of oil which must be borne by the sea will surely increase.

What Oil Does to Life

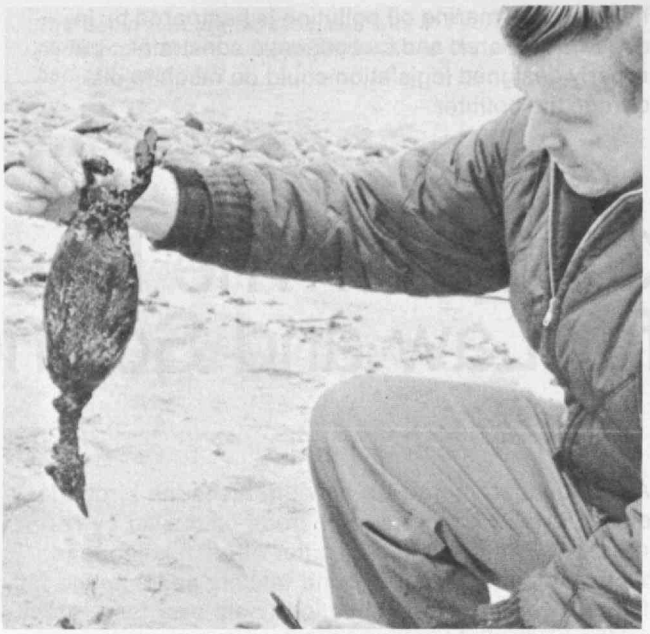
What harm can come from polluting the sea with so much oil? We do not know for certain, but research has suggested some possible harmful consequences. One of these relates to the biochemical fate of crude oil dispersed in the sea. Some hydrocarbon components of crude oil are readily degraded by marine bacteria, but this process is accompanied by a corresponding reduction of the sea water's oxygen content, which is essential to sustain marine life.

Other components, especially aromatics, may not be degraded before they are incorporated, essentially unaltered, in early stages of the food chain. At each succeeding stage there may be a further concentration. Thus, fish may be found to have much higher concentrations of artificial hydrocarbons than the zooplankton. (It is this same concentration mechanism which results in high DDT levels in fish and in the birds which feed on them. The fluorinated hydrocarbons are especially resistant to biological degradation.) In high enough concentration the aromatic components are toxic, and some of them are carcinogenic. The possibility of contaminating the world's fish food supply cannot be ignored.

There is another possible danger. Marine life also manufactures natural hydrocarbons, which appear to play essential roles in maintaining life in the sea. For example, fish like the salmon that move inland to spawn are probably guided to their spawning grounds by small traces of natural hydrocarbons. Such compounds may also be essential as sex attractants in some species, and introduction of foreign hydrocarbons might inter-

A year ago, hundreds of birds were trapped in oil spilled by a tanker in Long Island Sound. The picture shows Mr. Morgan Miner, chairman of the Waterford, Conn., Parks and Recreation Commission, examining ducks killed in this incident.

More recently, in September last year, over 100,000 gallons of diesel fuel leaked from a grounded barge off Cape Cod. The oil company hired workers to deploy this containment boom to save the shoreline. However, clam and oyster beds appeared to have been destroyed. (Photos: AP)



fere with their reproductive processes. An estimate of the amount of natural hydrocarbon in the sea leads to the conclusion that each year as much foreign hydrocarbon is introduced from oil spills as is naturally present.

Because most oil spillage is associated with ship loading operations and offshore oil exploration and production, the coastal zone bears the brunt of the pollution. This zone is also the most important to marine life, being the breeding ground for many fish as well as the habitat of shell fish and crustaceans. Considering the burden already placed on the edge of the sea by sewage, industrial waste, and insecticides dumped into it from sanitary systems and river drainage, the addition of oil may not have a dramatic effect on the few forms of life able to survive this multiple onslaught. But because oil floats on water and can be moved hundreds of miles by wind and current, an oil spill can bring damage to regions well removed from estuarine pollution, or even to those which have successfully solved their local pollution problem.

Why is so much oil spilled into the sea? It is the result of a combination of cost and carelessness. The value of the oil lost, expressed as a percentage of the value of the oil transported or mined, is too little to pay for the expense of preventing its escape. It is much like the dripping faucet: the water saved by curing the leak will hardly pay the plumber's bill. The economics of carelessness is similar. Oil lost through a leaking valve or burst hose is a lesser expense than an effective inspection and supervision system coupled with preventive maintenance.

In some instances there are indirect advantages to abating oil pollution which tend to offset its costs. One example is the growing practice of decontaminating oil ballast water before discharging it from tankers. This is done in conjunction with the cleaning of the tanks prior to loading them with oil, a practice which reduces the salt content of oil delivered at a refinery and thereby the cost of refining it. However, such cases are the exception rather than the rule.

Major catastrophes, such as the grounding of the *Torrey Canyon* or the blow-out of the Union Oil well in the Santa Barbara channel, appear at first glance to be inescapable accidents—the inevitable price to be paid for progress in increasing the world's annual production of petroleum. On closer examination, both of these incidents reveal a failure of management to supervise adequately a potentially dangerous operation and a tendency to cut costs while incurring extra risk. It can be questioned whether the occurrence of such events can be deterred solely by the assessment of liability for damage.

Chemicals and Barriers

Given the present magnitude and frequency of spills, what can be done to reduce the damage to marine life? Currently, there are two general approaches: chemical treatment of the spilled oil, and mechanical containment and collection. In the first method, detergents or dispersants are sprayed on the slick, preventing its adhering to solid surfaces and breaking it up into tiny globules which then dissolve or decompose through bacterial action. In the second case, the oil slick is surrounded by a floating boom or other barrier and is then collected by pumping or absorption.

Chemical detergents and dispersants have two drawbacks. They can themselves be toxic to marine life, and they do not actually remove the oil from the marine environment but merely accelerate natural processes. In the *Torrey Canyon* disaster, much of the damage to marine organisms was caused by toxic components of the liquid in which the detergent was dissolved. A water-soluble dispersant has recently been developed which is claimed to be nontoxic. At best, a dispersant can be helpful in preventing the spread of an oil slick to a region, such as a shellfish area, where it might be more harmful than in its original location.

Floating or pneumatic booms are sometimes used as a precautionary measure in protected slips or channels adjacent to unloading terminals. Existing containment and collection devices are ineffective in the presence of waves, tidal currents, or strong winds. At the present time there is no system which will contain and collect oil spilled in an open estuary, bay, or sound, except under unusual conditions of calm or slack tide.

Why have we not developed successful methods or systems for controlling or cleaning up oil spills? There are two reasons. First, there is an insufficient market for such control systems, and secondly, there has been no program, either public or private, to foster their development. The present market is so small that the costs of developing an adequate system cannot be recovered from the meager sales. In consequence, the performance of present systems is marginal, since there is insufficient basic technological information to ensure their proper design.

An exception is the case of detergents and dispersants, for which the development costs have been charged against other, more profitable applications. The oil industry, despite its vast size (of the ten largest corporations in the U.S., four are oil companies), does not finance development of the systems it needs but purchases them on the open market—ships from shipbuilders, drilling platforms from bridge builders, refineries from construction companies. The small market for oil pollution control systems is supplied by small-scale entrepreneurs who are unable to finance adequate development programs unless they receive outside aid.

Attempts at Legal Controls

Federal and state agencies concerned with oil pollution are struggling to help private interests to develop control systems. Their efforts are hampered by the complete lack of any backlog of scientific and technological understanding of the problem, as well as by their inexperience in managing research and development programs. In contrast, the expedition which succeeded in landing astronauts on the moon was the culmination of an expertly managed program of 15 years' duration backed up by 40 years of research and development in rocket technology. Although the task of developing an oil pollution control technology is one of much lesser magnitude, it cannot be solved in the absence of research-based understanding and management expertise.

Given our present limited ability to reduce the damaging effects of oil spills, what can a community do to reduce the frequency and size of such spills? I believe it is necessary to institute an oil pollution control program, designed to provide many simultaneous inducements to abate pollution. Such a program should require:

1. Financial liability for damage caused by oil spills;
2. Pre-approval examination of the design and construction of oil handling facilities whose operation is proposed;
3. Periodic inspection and testing of these facilities;
4. Licensing of operating personnel;
5. Specifications of safety procedures; and
6. Supervision by on-site pollution control inspectors.

A program of this type would require the creation of a public agency manned by an experienced, well trained staff of sufficient size to carry out the necessary inspection and monitoring services. In large measure the cost to the public of the operation of such an agency could be recompensed by fees levied against the industries which require these services.

A pollution control program, in any field, succeeds by persuading potential polluters that it is easier and more efficient to abate pollution than to resist or evade the controls imposed or to oppose them through expensive adversary proceedings in the courts. Most businesses, like most citizens, are law abiding and respect the public intent expressed by the formation of a regulatory agency. For the few recalcitrant or even extremely careless operators, civil action in the courts will be required.

If the foregoing remarks on the oil pollution problem indicate little hope of an immediate reduction in its severity, then they properly portray the present situation. In order to secure any noticeable improvement three types of action are needed:

1. Enactment of legislation at national and state levels to establish the legal framework for instituting and enforcing abatement procedures;
2. Establishment of local or regional control agencies; and
3. Initiation of research and development programs to supply the technology and scientific understanding required to make abatement possible.

If such a public program is undertaken, oil pollution can be reduced substantially.

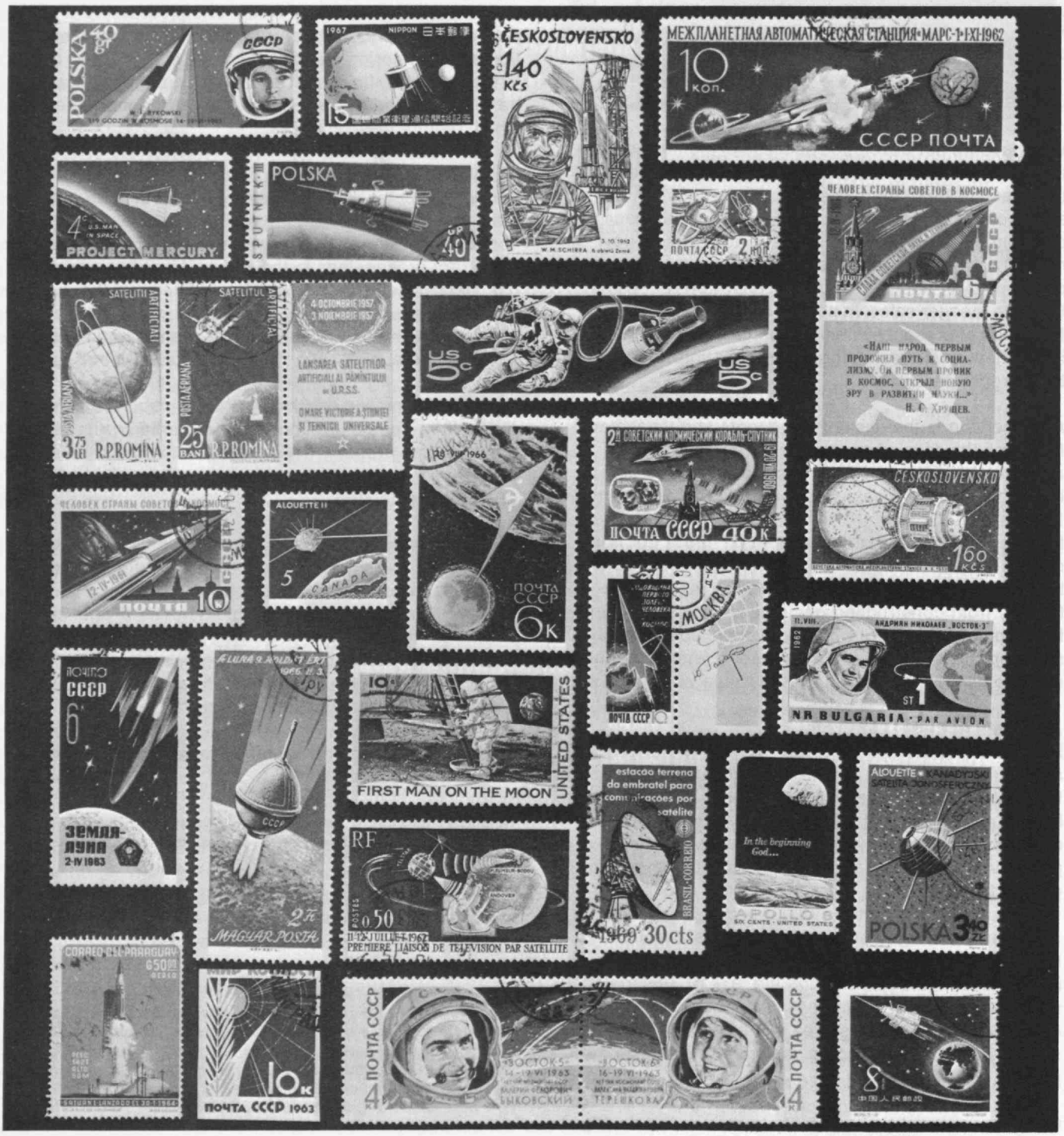
Selected Readings

David P. Hoult, ed., *Oil on the Sea*, Plenum Press, New York, 1969.

International Conference on Oil Pollution of the Sea, Warren and Son, Ltd., Winchester, U.K., 1969.

James A. Fay is a graduate of the Webb Institute of Naval Architecture (1944) and M.I.T. (1947), where he studied marine engineering. With a doctorate from Cornell, he joined M.I.T.'s Mechanical Engineering Department in 1955. His research interests have included high-speed gas dynamics, magnetohydrodynamics, combustion, re-entry physics, and more recently air and water pollution. He is chairman of Boston's Air Pollution Control Commission.

Even such modest symbols as postage stamps suggest at once the international appeal of great achievements in space and the strong national pride which follows from every success in this ever-growing endeavor. Can these two influences be joined in a world community effort to explore the mysteries of outer space?



The case for internationalizing outer space research is clear. Can we now fulfill the dream of a great multinational exploration?

Craig R. Eisendrath
Education Research Center, M.I.T.

To Internationalize Outer Space Research

Why should the United States continue to go it alone in outer space?

This article argues for an internationalization of instrumental space flight and proposes political arrangements whereby it might be effected. The internationalization of manned flight is a more complex issue, and this article simply suggests lines along which it should be studied.

The Moon Shot and National Prestige

The arguments for an international as opposed to a national program of outer space research were advanced in 1963 by President John F. Kennedy just two months before his death. The late President said: "Why should the United States and the Soviet Union, in preparing for . . . expeditions [to the moon], become involved in immense duplications of research, construction, and expenditure? Surely we should explore whether the scientists and astronauts of our two countries—indeed, of all the world—cannot work together in the conquest of space, sending some day in this decade to the moon, not the representatives of a single nation, but the representatives of all humanity."

Ironically, the manned program was precisely that part of the space venture which *least* lent itself to international cooperation. To be sure, the United States has required tracking stations abroad and assurances of the return of our astronauts should they down in foreign territory. But when officials of the administration began examining the President's offer—it had been inserted into his speech by his aide, Arthur Schlesinger, Jr.—they found it simply wouldn't work.

The fact was that if we were to go through the enormous expense and effort of landing a man on the moon, we would want the credit for it. And beyond that, the contracts had already been let, the facilities planned, the political commitments made to many of the congressmen in whose constituencies the facilities were to be located. The very delicacy of the operation itself would make the integration of different national programs unfeasible, or so N.A.S.A. officials felt. The problem of integrating the engineering components would be close to insuperable, of integrating the astronauts worse still. A Negro perhaps, but not a Soviet.

And so the President's offer was quietly buried. This is not to say that President Kennedy's offer of cooperation in manned flight may not one day be made good. But it was clearly premature, both technically and politically.

Internationalization of Instrumental Missions

On the other hand, the internationalization of instrumental missions poses far fewer problems than the internationalization of manned flight. While manned flight tends to build up a complex operational know-how which is difficult to communicate because it is built around human-oriented systems, the techniques and findings of instrument missions easily pass into the common scientific domain. Manned flight is so delicate, so finely meshed an operation that foreign involvement can be awkward, but instrumental flight lends itself well to such involvement.

The United States, for example, has already assisted several countries, including Britain, France, and Italy, with their own launches. Moreover, space in instrument payloads can be given to countries which cannot orbit their own vehicles, and the United States has taken the lead in providing such service. In addition, launching facilities can be internationalized—a sounding rocket facility, for example, has been in operation for some years at Thumba, India, under United Nations auspices; and the United States orbital facility at Wallops Island has to some extent taken on an international character. Finally, manned flight cannot be broken up into many different missions because an individual mission, such as landing a man on the moon, absorbs all available funds. Instrumental missions are far less expensive, so there can be many more of them, and some can easily be allocated to different countries.

The I.G.Y. Precedent

Significantly, outer space exploration began as part of an international program, the International Geophysical Year of 1957-58. This was the period in which the Soviets launched their Sputnik I and the United States its Vanguard I and Explorer I—all instrumental missions.

I.G.Y. was run by the International Council of Scientific Unions, whose members are national academies of science. Decisions were reached by committees of scientists, not governments, and coordination of the I.G.Y. program in the space field was loose at best. The Soviet Union often went its own way and, unlike the United States, severely restricted information on its launches.

While the outer space aspect of I.G.Y. was in many respects the least successful aspect of the program, it may well offer a promising precedent for future outer space arrangements.

Military Obstacles

Perhaps the chief obstacle to greater success in the outer space field of the I.G.Y program was the close connection in the 1950's between military missiles and non-military rockets. The Soviets and the United States were both engaged in developing effective I.C.B.M.'s which could deliver heavy warheads. Boosting a payload into outer space presented similar problems, so that the technology was to some extent interchangeable. Today, however, the technology of the two fields has split. Missiles demand highly specialized engineering: decoys, multiple launches, jamming, and precision guidance have little to do with the engineering of outer space launches.

Another problem in the 1950's was that the military possibilities of space were wildly overestimated. It was felt that the nation which controlled outer space would control the earth. Indeed, an engineer told the author that a year before the Vanguard launch he was drawing up plans under government contract for 10- to 20-man military stations on Mars. Today such ideas have been shelved, and—in any case—the outer space treaty, to which both the United States and the Soviet Union are signatories, severely limits the military uses of outer space.

By the act of 1958, U.S. non-military space research is sharply differentiated from military research and is entrusted to a civilian agency, N.A.S.A. This makes it clear that international commitments could be made without affecting the military aspects of our space program allowed under the treaty. The United States is thus ideally positioned to participate in a program of international research in the peaceful uses of space. No matter what provisions were made for our non-military research, the Department of Defense would be able to continue its program along the present basis. With the military applications of outer space research no longer a major impediment, the time would seem ideal for another try at international coordination.

Advantages of an International Program

An international program for peaceful uses of outer space presents many advantages. First of all, with many countries operating in outer space, such a program would insure the selection of priorities of international interest and the elimination of redundancies resulting from competing national programs. Secondly, the program would provide for immediate exchange of information, thereby eliminating present delays that are so often frustrating and costly to scientists. Thirdly, the program would increase international cooperation between East and West which would be both a sign and a cause of reduction in international tensions. And finally, such a program would recognize the common interest of all mankind in outer space by making its exploration a common venture.

The Proposed Arrangement

Two steps are suggested to effect such a program, one scientific and the other political. First, the United States could take the initiative in proposing a permanent I.G.Y.-type arrangement for the future exploration of outer space. The appropriate organ for the scientific community would be the International Committee for Space Research (COSPAR), an executive body organized in 1958 by the International Council of Scientific Unions, precisely to put I.G.Y. on a permanent basis. Under the proposal presented here, COSPAR would coordinate the plans of the scientific community into a single program of international research and *assign tasks* on the basis of capability and interest.

A further political step would be needed. After the I.G.Y. meetings in 1957-58, scientists had to persuade their own governments to accept the tentative agreements which the scientists had entered for I.G.Y. participation, a procedure which was both cumbersome and unreliable. A political organization, representing countries conducting outer space research, could handle the necessary political coordination far more effectively. Fortunately, a political body is already at hand—the United Nations Committee on the Peaceful Uses of Outer Space, a 28-nation committee which reports to the General Assembly (and whose decisions in practice the Assembly automatically ratifies). It is this Committee which for the most part prepared the outer space treaty.

What is envisaged here is a working arrangement whereby the U.N. Committee on the Peaceful Uses of Outer Space would review for political purposes programs suggested by the international scientific community, as represented by COSPAR. Actually, such an arrangement is already being followed, although not on any significant scale. Meetings of COSPAR usually precede those of the U.N. Committee's Scientific and Technical Subcommittee, and to some extent suggest its agenda. But more significantly, the arrangement outlined here would seek to strengthen greatly COSPAR's coordinating role in outer space and to place on the U.N. Committee's agenda the entire effort of all nations in outer space research. It would give to the U.N. Committee an executive role which it has today in only the smallest part.

The immediate question which this suggestion raises is that of political feasibility. Fortunately, both organizations already operate on a basis of consensus which

assures that any enhancement of their powers would be at least minimally objectionable. While COSPAR is technically subject to Soviet veto, as well as to our own, it generally reaches decisions in the way scientists usually do business: on what is practical and sound scientifically—that is, on the basis of consensus.

The U.N. Committee proceeds the same way, though for somewhat different reasons. Originally, the Soviets insisted on absolute parity of membership in the Committee, an arrangement which the United States and others maintained would unjustly conflict with the representation of Soviet countries in the General Assembly as a whole. Accordingly, an unwritten compromise was reached. The Soviets were given a disproportionate number of seats in the Committee, although fewer than enough for parity; and, according to a statement of the Committee's chairman, they were given an informal guarantee that decisions would be reached by consensus. Such a way of reaching decisions seems essential to the proposed arrangement, as it is inconceivable that the United States or the Soviet Union would participate on any other basis.

Would such a program work? While complete coordination and full information exchange could be broached as final goals, they need not be achieved at once. They could be reached by small, confidence-building steps as the arrangement worked itself out. Perhaps the U.N. Committee might some day control the program of outer space research by all U.N. members by directly administering the research budget. Or a specialized agency, perhaps on the model of the International Atomic Energy Agency, could be established within the U.N. structure for the conduct of outer space research. But such ideas look too far and for the present are simply not realistic. The whole history of our relations with the Soviets indicates their tendency to see our "bold initiatives" as attempts to have them sign blank checks. The present proposal does not do this. It would work gradually and with existing mechanisms, and while indicating a forward path, it would not bar retreat to present procedures.

Manned Flight

We have suggested that a major impediment to internationalizing *manned* flight has been its enormous national prestige. But this is likely to diminish. After the lunar landing of last summer, there is no goal in the foreseeable future of comparable importance. More men on the moon, a permanent station, the erection of increasingly complicated facilities—none of these has the same mystique. And after the moon, the next targets in the solar system are many millions of miles away, not a few hundreds of thousands. While a landing on Mars might achieve unprecedented international interest, it is a long time away and promises to be incredibly expensive.

In the last eight years, N.A.S.A. has spent $33.8 billion for research and development, mostly on the manned program; the Department of Health, Education and Welfare and the National Science Foundation have together spent $8.9 billion for research and development. Were the United States to push ahead with a manned program along the old lines, lunar or Martian, this ratio would continue to grow still more lopsided. Meanwhile, we have pressing domestic needs which are being sacrificed: health, housing, transportation, and education.

The last four years have seen the Great Society gutted for lack of funds. No doubt the main culprit has been Vietnam, but until we can reduce our military commitment, we have no assurance that defense expenditures will not continue at the present level. This suggests that it is time to submit our manned space program to serious reappraisal and perhaps to curtail it wholly or in part.

But however the program is continued, it would seem wise to explore ways in which its great cost could be shared, particularly with the other major space power, the Soviet Union. The technical problems are, as we point out, difficult; the leadtime for implementing such a program would be substantial. But this is all the more reason to begin the study. For example, will the arrangements suggested above for instrumental flight be a fruitful direction for manned flight?

An Immediate Initiative

The internationalization of instrumental space research is a proposal which we could make almost immediately. Such a proposal, associating President Nixon with support for international cooperation, would be an act of statesmanship which would lend prestige to his administration. Though the first men on the moon were Americans, perhaps the first instrumented laboratory on Mars could represent the United Nations—and thus the world community's united effort to explore outer space.

Suggested Readings

Walter C. Clemens, Jr., "Outer Space, Strategy, and Arms Control," *Technology Review,* Vol. 69, No. 8, June, 1967, pp. 18-21.

Arnold W. Frutkin, *International Cooperation in Space,* Prentice-Hall, Englewood Cliffs, N.J., 1965.

Richard N. Gardner, *In Pursuit of World Order: U.S. Foreign Policy and International Organizations,* Praeger, N.Y., 1964.

Craig R. Eisendrath was a U.S. Foreign Service Officer from 1958 to 1965. During two assignments with the United Nations Political Office he had responsibility for the multilateral aspects of the U.S. space program. A graduate of the University of Chicago, he has done graduate work at Georgetown and Harvard Universities. At present attached to M.I.T.'s Education Research Center, he is now doing post-doctoral research in Europe. This article is dedicated to his father, Ralph H. Eisendrath.

A large-scale explosive driver in action. The author describes efforts to apply the principles of shock tubes to achieve higher velocity gas expansions in devices called explosive drivers.

Explosives can be used to generate controllable streams of gas at very high energy. Space vehicles and defense systems are among the beneficiaries of this dramatic technique

Charles S. Godfrey
Chief Scientist and Vice-President
Physics International Company
San Leandro, California

Uses of Explosive Driven Gases

The term "energy conversion" covers activities with a wide variety of objectives—electric power at high voltages, mechanical power at high rates of motion, and so on. One of the less familiar objectives is to concentrate as much energy as possible in a given mass of material. The material, which will usually be in gaseous state, can then in turn act as a power source for hypervelocity or hypertemperature phenomena. This is the basic principle behind all shock tubes, shock tunnels, and light-gas guns.

In addition to their utility in hypervelocity applications—aerodynamic and impact studies—high energy-density gases can be useful for blast simulation, chemical synthesis, ablation studies and as intense sources of radiation.

Although extensive effort has gone into the development of these devices over the past several years, they have reached a plateau of performance, limited by the energy and power density that can be imparted to the gas by the driving (or energizing) methods generally employed. The challenge is to increase this density while keeping the process orderly and controlled. This article will describe a new device which, for lack of a better name, we call an explosive driver.

The basic idea is quite simple: a thin-walled metal tube, filled with the gas, is surrounded by a concentric cylinder of high explosive (Figure 1). A detonation initiated at one end of the explosive collapses the metal tube as the detonation wave-front propagates along its length.

The process can be visualized by imagining oneself squeezing the rear of a toothpaste tube between the thumb and forefinger and then briskly moving the two fingers to the front of the tube. Under the proper conditions, the gas is projected down the tube at high velocity—in fact at the detonation velocity of the explosive.

The effect is equivalent to that of a piston moving from one end of the tube to the other at this same velocity. We so shall use the term "virtual piston" to refer to the point of collapse of the tube. As one might expect, such a piston tends to become leaky—a fact of some importance, as we shall see.

If the detonation velocity of the explosive exceeds the velocity of sound in the gas (as is always the case), a shock front will form in the gas ahead of the piston. This shock raises the temperature of the gas, and at the same time is responsible for accelerating it to the velocity of the piston. It is interesting to note that the internal energy of the shocked gas (manifested by its temperature) is nearly equal to its directed kinetic energy. Since both forms of energy are of interest to us, we will use the term "energy" as meaning both internal and directed kinetic energy. The two forms of energy are readily convertible one to another. Kinetic energy can be converted to internal energy by making the gas impinge on a rigid wall, and internal energy can be converted to kinetic by allowing the gas to expand directionally, as in a rocket nozzle.

Physics of Controlled Explosion

The performance of a driver is usually considered in terms of what gas pressures or temperatures can be achieved. By applying the conservation laws across the shock front, we can formulate simple relations between the initial and final state of the gas. We find that (until effects of dissociation and ionization become large) both the shocked pressure (P_1) and temperature (T_1) are proportional to the *square* of the detonation velocity (D). Also, the shock pressure is proportional to the density of the starting gas (ρ_0); and the shock temperature, to its initial temperature (T_0) and molecular weight (M). As equations: $P_1 \propto \rho_0 D^2$ and $T_1 \propto T_0 M D^2$, in which $\propto$ expresses a relationship of proportionality.

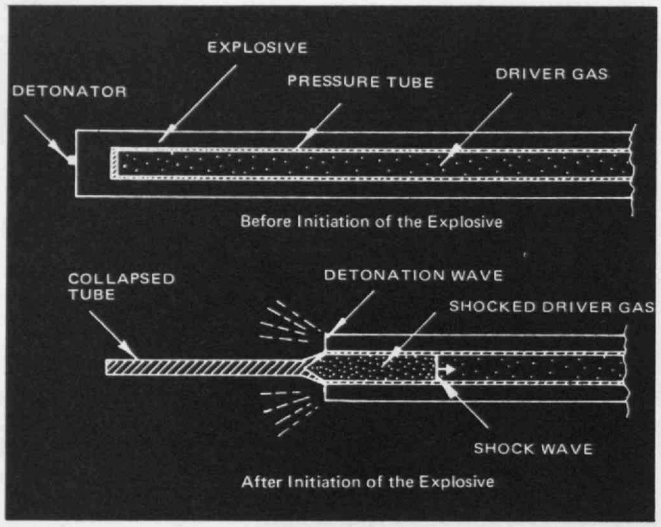
For example, suppose that helium (M=4) is in the tube initially at 300° K. and a density of 0.0356 g./cu.cm. (i.e. a pressure of 200 atm.). Using nitromethane (a colorless liquid in wide use as a fuel by model airplane enthusiasts and dragsters), whose detonation velocity is 6.2 km./sec., we find that P_1 is 18,200 atm. and T_1 = 6850° K. In addition, the helium would be moving at 6.2 km./sec. If argon (M=40) were used instead of helium, the temperature given by the ideal gas approximation would be 68,500° K. Because of ionization effects the actual temperature of the expanded argon gas would be 20,000° K.

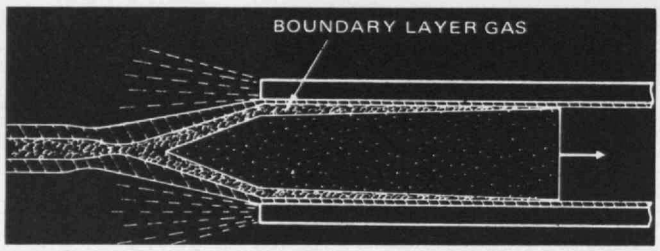
Using conventional explosives in the simple geometry shown in Figure 1, it is readily possible to achieve pressures of 500 to 20,000 atm. and temperatures of 5,000 to 20,000° K., and these figures by no means represent the upper limits of performance.

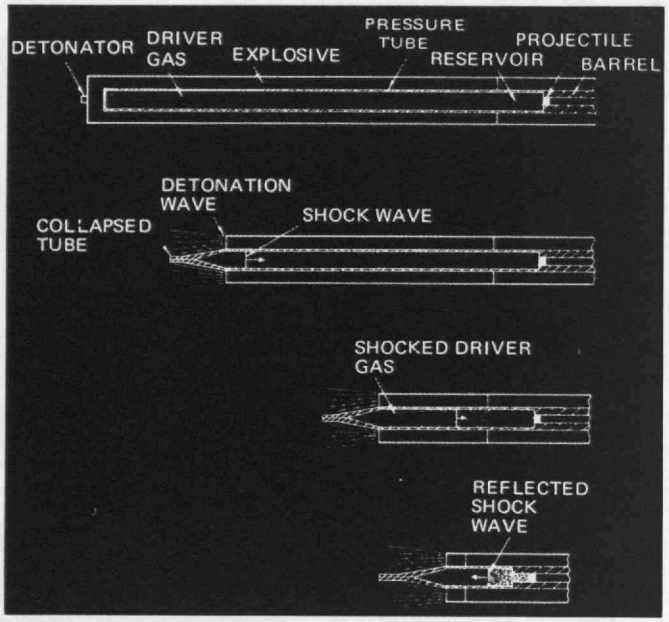
Figure 1. The operation of the simple type explosive driver

Figure 2. A limitation on the length of an effective driver arises from the existence of a boundary layer which remains behind the advancing detonaticn as a source of leakage

Figure 3. Use of an explosive driver to drive a projectile







One might ask—Why use high explosives? Why not use some other source of energy, such as electrical? The principle described above is, in fact, being employed successfully in tube-collapsing devices which use, instead of high explosive, electromagnetic forces, generated by the discharge of a capacitor bank. However, it is not always recognized how efficient high explosive is as a means of energy storage. The best industrial capacitors can store 0.4 joule/cu.cm. as compared to 8×10^3 joule/cu.cm. for high explosive. The cost per stored megajoule in capacitors is $100,000, for high explosives $0.17. It is also interesting to compare the maximum rates at which energy can be taken from the two systems. In the case of the capacitor system the maximum velocity is limited to the speed of light, 3×10^{10} cm./sec. For the explosive system it is limited to the detonation velocity, typically 8 km./sec. Using these numbers it is found that the maximum rates of energy extraction for the two systems are roughly equal.

We should also consider efficiency—by which we mean the proportion of the chemical energy released by the explosive that is imparted to the gas. Any process of concentrating energy is likely to be inefficient. In terms of temperature, we are starting with explosives having detonation temperatures of a few thousand degrees Kelvin and attempting to heat gases to temperatures perhaps an order of magnitude higher. Somewhat surprisingly, efficiencies range from 5 to 20 per cent.

Suppose we wish to use the explosive driver to add a million joules of energy to a gas. Using nitromethane at a cost of $0.35 per pound, and assuming an efficiency of 10 per cent, the cost of the explosive comes to only $1.70. Equally impressive are the energy densities that can be achieved for this expenditure. Specific energy densities may be as high as 100,000 J./g.—over an order of magnitude higher than that of the explosive itself!

What Are the Limits?

One might think that the driver could be made any length and could generate an arbitrarily long pulse of high-energy gas. Unfortunately there are two basic limitations. The first stems from the fact that we must contain whatever pressure we create. If we shock the internal gas to 15,000 atm., for example, then this pressure must be contained behind the shock front until the detonation front arrives. Within limits, this problem can be met by enclosing the high explosive in a pressure vessel.

A perhaps more fundamental limitation results from the viscous drag between the moving column of shocked gas and the inside of the tube. A stagnant layer forms at this interface, and grows until some of it is trapped by the collapsing tube—our virtual piston springs a leak (Figure 2). As the length of shocked gas increases, the rate of leakage increases until it equals the rate at which gas is being shocked—after which the length of the shocked column of gas remains constant. Experimentally, using nitromethane with helium, this limiting shock length is about 25 times the diameter of the gas column.

Fastest Gun in the West

One of the most obvious applications of these devices is in the acceleration of projectiles to hypervelocity. The ultimate driving mechanism in conventional light-gas guns is the expansion of hot hydrogen or helium gas. One can visualize the propellant chamber of a conventional gun replaced by an explosive driver (Figure 3). The hot helium expands down the barrel accelerating the projectile ahead of it. Although the concept sounds simple, the detailed design of successful guns has evolved over a period of several years and is still being improved. At present, this design of what might be called a single-stage gun has successfully accelerated two-gram projectiles to 10.6 km./sec.

Although this performance in itself does not represent a significant breakthrough in the state of the art, the size of the gun does. The explosive gun is 6 ft. long and weighs about 100 lb. (Figure 4). A light-gas gun performing comparably would weigh many tons. Of even more significance is the fact that the explosive gun can be scaled to larger sizes with assurance that it will still achieve the same velocities. The largest explosive gun fired to date accelerated a 2.3-kg. cylinder of plastic to 6 km./sec., using approximately 3000 lb. of high explosive (Figure 5). Projectile shapes are not limited to cylinders. By using sabots which are diverted from the line of flight after the projectile is launched, it has been possible to launch spheres and slender cones (Figure 6).

One of the limitations to using ballistic ranges to

Figure 4. A single-stage gun which fires a 2-g. projectile

Figure 5. Setting up an explosive driver which accelerates a 2.3-kg. projectile to 6 km./sec.

Figure 6. Non-cylindrical projectiles can be driven by enclosing the test-object in a "sabot" which falls away in flight

study re-entry phenomena is the small size of the models that can at present be launched. The successful launching of large models would open up a whole new spectrum of laboratory tests. Now in the fabrication stage is a gun which will launch a stable slender cone of 15 kg., having a base diameter of 6 in., to approximately 5 km./sec. A permanent facility for launching and diagnosing subsequent vehicles is also being planned (Figure 7).

An inveterate TV watcher would recognize immediately that being the fastest gun in the West was a matter of survival. A fast gun capable of launching small projectiles to meteoroid velocities may be necessary to insure the survival of our space vehicles, by testing the ability of various structures to withstand controlled impacts by simulated meteoroids.

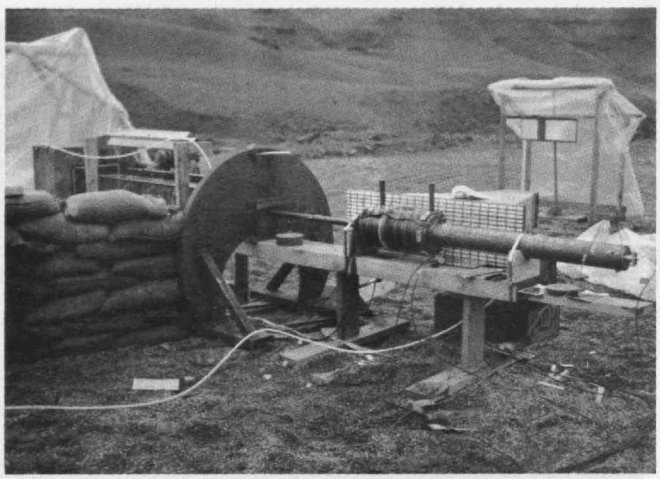
The average velocity with which a meteoroid would impact a space vehicle is approximately 30 km./sec. The single-stage gun described above has an upper limit of approximately 11 km./sec. This limit is set primarily by the fact that piston velocities, for the geometry described, cannot exceed the maximum detonation velocity of available high explosives—9 km./sec.

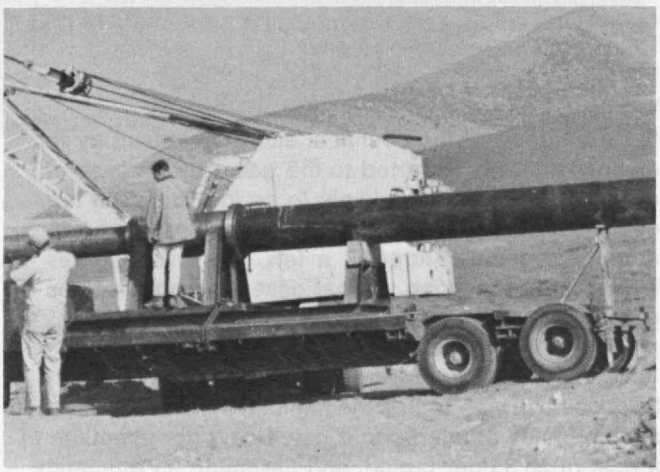
However, other geometries are possible, which have the effect of causing the piston to move faster than the detonation. The trick is to make the detonation travel at an angle to the axis of the gun. To control the direction of the detonation, we combine two explosives of different detonation velocity, as shown in Figure 8. This idea is known as "lensing," by analogy with an optical lens (in which the difference in velocity of light in two media is used to control the direction of propagation of the light). By controlling the shape of the interface between the two explosives, the piston can be "programmed" to follow any desired acceleration history.

This technique has so far successfully accelerated a two-gram projectile to 12.1 km./sec. It is probable that at least 20 km./sec. can be attained.

High Temperature Aerodynamics

For studying the properties of gases at high temperatures one valuable tool is the shock tube, in which, usually, the expansion of a driver gas is employed to impart a shock to some test gas. The shock tube pro-





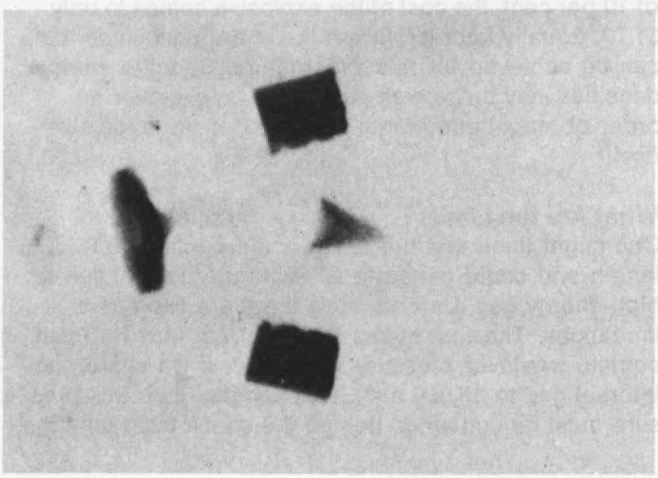
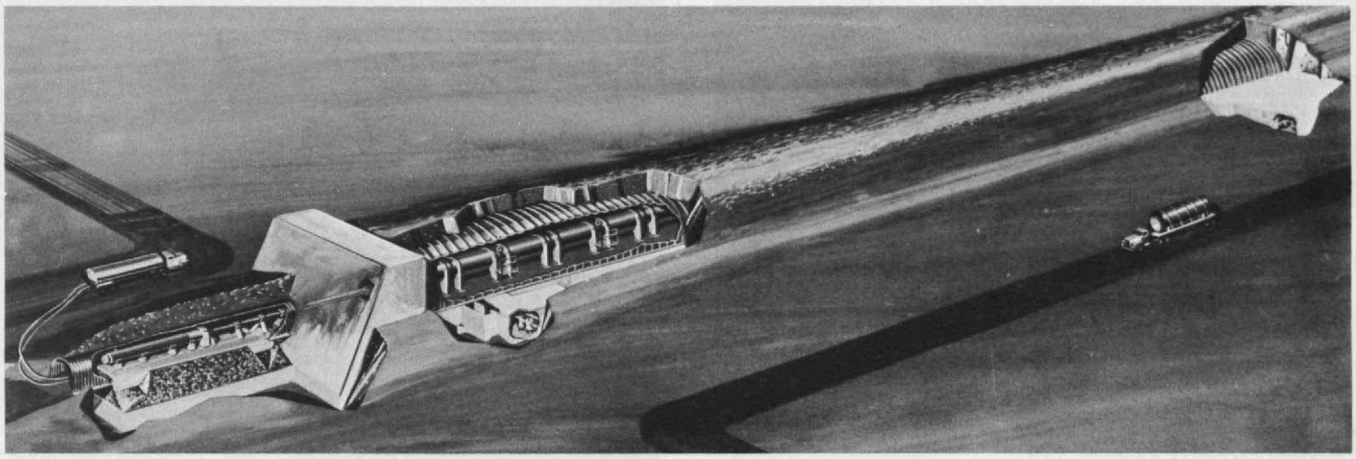


Figure 7. A proposed facility for launching large projectiles



vides short-duration flows of known thermodynamic states at high enthalpy (thermodynamic potential). By putting a body in the path of the shock, the interaction and flow around the body can be studied.

Unfortunately, the Mach number behind the shock is too low to be of interest for many applications. A modification of a shock tube, called a shock tunnel, allows the generation of hypersonic gas flows at high Mach numbers. In its basic form it consists of a shock tube to the end of which is added an expansion nozzle; variations of this concept provide a means of simulating a wide range of conditions such as are encountered during entry of a space vehicle or missile into various gaseous atmospheres.

Explosive drivers would be ideal for these devices. Based on the success of initial tests, a permanent 4-in.-diam. shock tube has recently been constructed. As much as 500 lb. of explosive can be used without damaging the shock tube. To date, this facility has had several "shakedown" shots, in which shock velocities of Mach 30 (10 km./sec.) and Mach 42 (14 km./sec.) were recorded in air, with initial pressures of 1 and 0.0005 atm. respectively. Although no shock *tunnel* experiments employing an explosive driver have yet been performed, feasibility can be assured from the success of the shock tube.

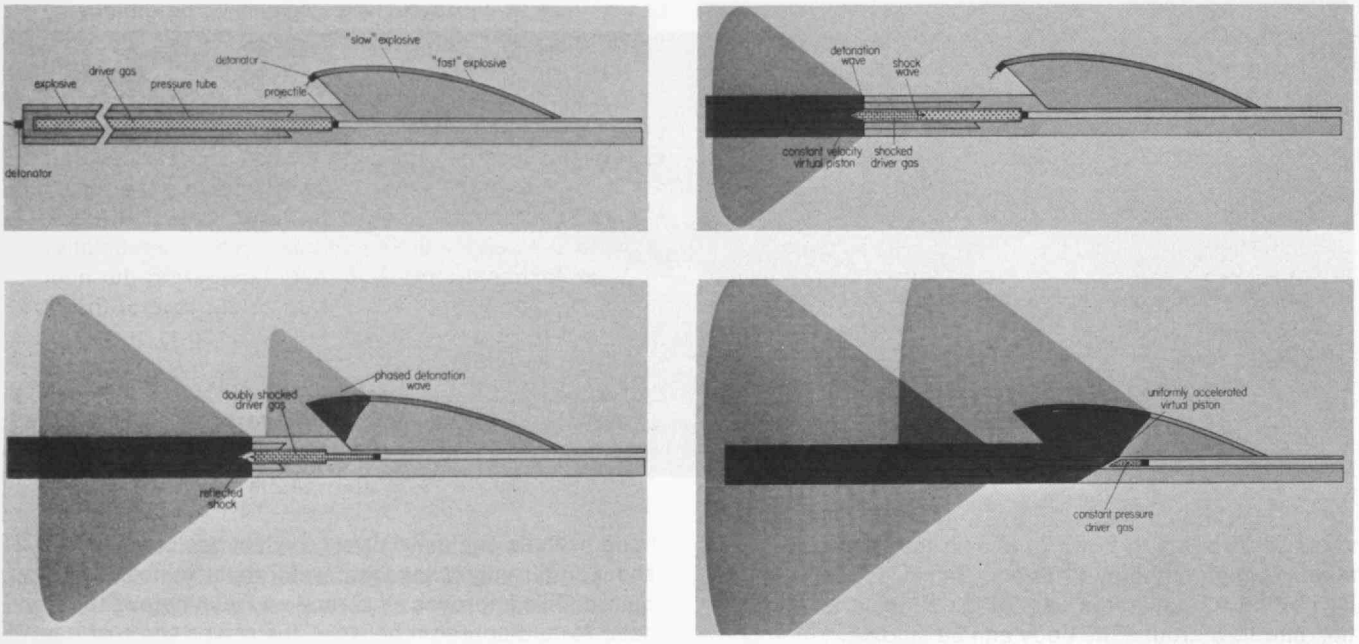
In most shock tubes, the driver gas is a detonating gas mixture or a gas heated by arc discharge. In either case, it is not suitable in itself as a test gas. On the other hand, with an explosive driver the test gas can be shocked directly to the temperature and velocity required. This improves efficiency and eliminates the need for a diaphragm between the driver and test gas.

Modelling Large Explosions

A particular application which has been explored in some detail is the simulation of the airblast that might be caused by a large atmospheric explosion. In this case the test gas is air initially at ambient temperature and pressure. Instead of using a tube to contain the gas, one can construct a rectangular duct with the ground as its lower surface, two vertical walls of earth fill, and a roof covered with a flat sheet of some such material as steel or plywood. On top of this "roof" is placed a layer of explosive. When the explosive is detonated at one end of the duct, the roof is driven to the ground as the detonation wave front propagates. By varying the cross-sectional area of the duct downstream of the explosive layer, one can tailor the blast profile that passes any given point.

Using this scheme, it is practicable to subject large-scale buildings or missile silos to the blast environment of a large-yield nuclear surface burst. The maximum pressure and temperature attained by the air are determined solely by the detonation velocity of the explosive—for nitromethane, 500 atm. and 10,000° K. A design has been seriously proposed which would shock 90 tons of air to these conditions and cause it to sweep over a structure at a velocity of over 6 km./sec.

Figure 8. Greater velocities than the detonation velocity of the explosive can be achieved by the technique of "lensing," in which the detonation moves obliquely to the direction



The piston velocity, as we have seen, need not be limited to the detonation velocity of the explosive. Just as lensing techniques can be used to improve the performance of explosive guns, they can also be used to obtain higher pressures and temperatures in shock tubes or blast simulators. It becomes possible to use these devices as sources of very intense radiation.

Let us assume, for example, that a lensing scheme is employed in an otherwise normal driver to give a piston velocity of 15 km./sec. This will shock atmospheric air to approximately 26,000° K., argon to 55,000° K. and xenon to 92,000° K. (approximate, because controllable techniques for generating such temperatures have not heretofore been available as a basis for equation-of-state measurements in this regime—one advantage of the technique will be to make such experiments possible).

A facility is now under construction which will be able to fill a one-foot-diameter pipe with high-density xenon at 55,000° K. The hot gas will be used to study ablation phenomena. Another interesting possibility will be to examine chemical synthesis of exotic materials under conditions of extreme pressure and temperature.

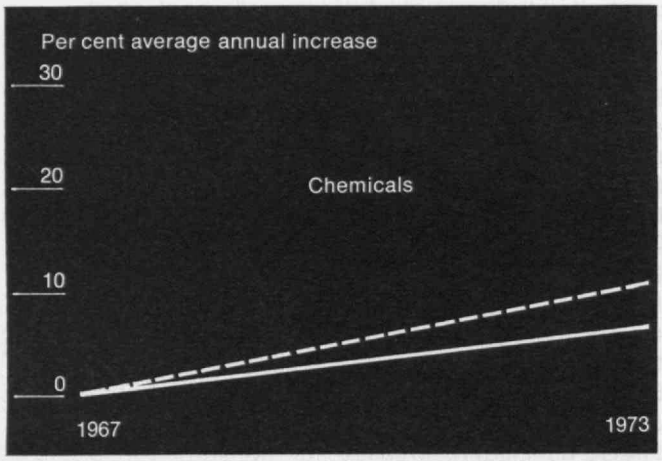
With so much in their favor, what are the disadvantages of explosive drivers? The primary limitation is one of test time. High explosives release their energy at pressures of a few hundred kilobars. Since it is impossible to contain pressures of this magnitude, high explosives can be used only where short time duration is no great drawback. At present a few milliseconds appears to be an upper limit for practical systems.

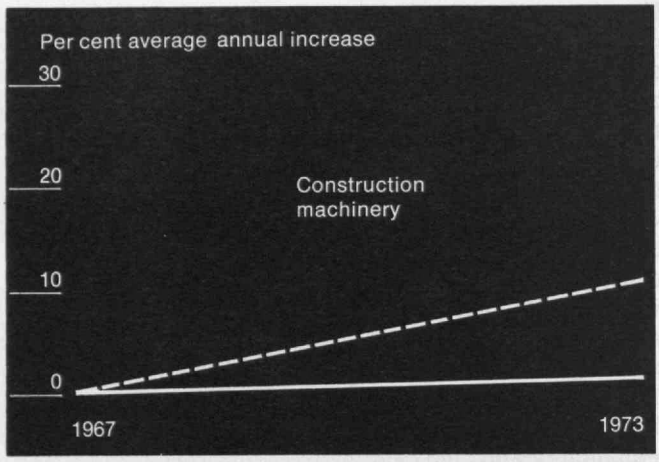
Another disadvantage is that a portion of the apparatus is destroyed in each experiment and must be replaced each time. However, the replaceable portion can be minimized, as is done in the permanent shock-tube facility mentioned above. Since the basic driver comprises only a thin-walled tube and the surrounding explosive, the replacement costs are often a small portion of the cost of an experiment. Indeed, in one new design, successfully tested, only the high explosive need be replaced between experiments. There are also physical and psychological problems which should not be discounted. But once the problems of safety, noise, flying shrapnel, blast, storage, local ordinances, and prejudice are addressed and solved, explosive drivers can be treated as routinely as any other potentially hazardous operation.

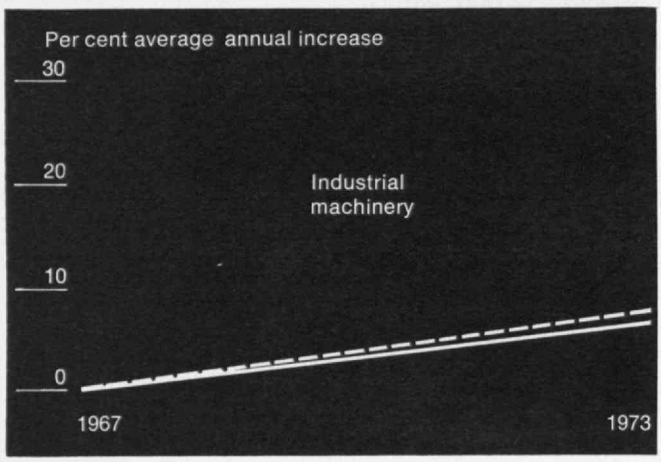
Explosive drivers are already being used in at least two government laboratories. The Ballistic Research Laboratory is using them for blast studies and is considering the procurement of expendable explosive guns for impact experiments. The Ames Laboratory of N.A.S.A. is using explosively driven shock tubes in a specially built containment tank. A primary concern in the near future will be to lengthen the useful test time of the drivers. More theoretical work is required to understand their detailed operation for the various applications, and some specific applications have still to be designed and tested. But the explosive driver has already demonstrated its ability to create a new generation of hypervelocity and hypertemperature devices.

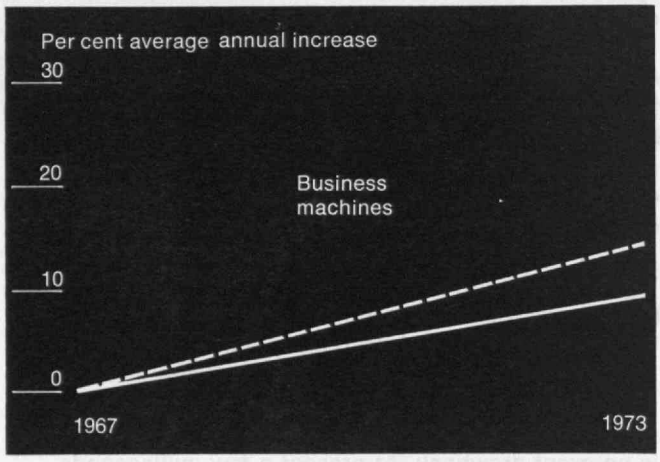
Charles S. Godfrey, Chief Scientist and Vice-President of the Physics International Company (of which he was one of the founders, in 1962), supervises research on the dynamic properties of materials, effects of nuclear weapons, and nuclear physics, as well as in the field described here. He graduated from M.I.T. in 1941, worked on the development of gunnery systems during the war years, and subsequently gained a doctorate in physics from the University of California, where he rose to Leader of the Physics Division of the Lawrence Radiation Laboratory, coordinating the efforts of 450 workers in the nuclear weapons field.

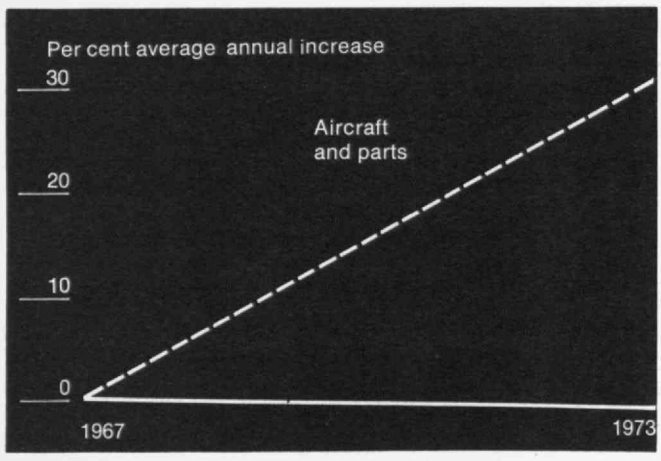
Without exception, import growth rates (broken lines) are projected to be higher than export growth rates (solid lines) in the six major commodity groups "expected to supply the largest share of the export 'action' during the next five years," as listed by the U.S. Department of Commerce. Yet each of these industries will continue to show a trade surplus in 1973, and the chemical industry's $2.3 billion estimated surplus will be over half as large as the entire U.S. trade surplus in 1967. (Data: Bureau of International Commerce)

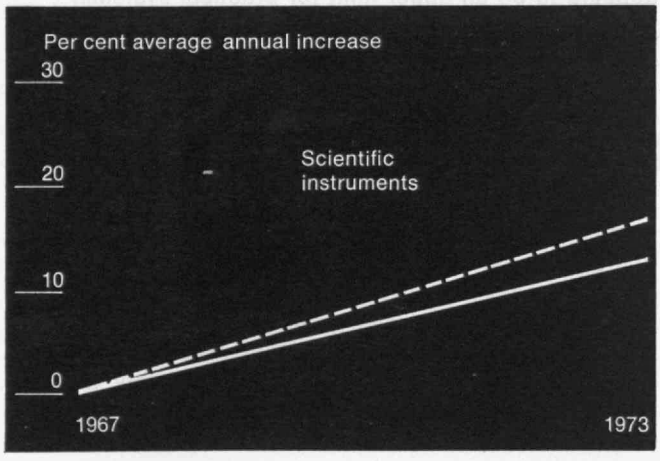












America's declining share of the world's high-technology industry and its worsening position in world trade are danger signs. We must add new impetus for innovation and ingenuity to avoid a continuing decline in international power

Philip H. Abelson
Editor of *Science*,
American Association for the Advancement of Science;
Director of the Geophysical Laboratory,
Carnegie Institution of Washington

A Challenge for the Seventies

Science and technology are important factors in almost every aspect of public policy. During the 1950's and early 1960's a major national concern was competition with Russia, both in military terms and in space. In this competition, science and technology had a crucial role. But now we realize that, while attention was focused on Russia, an important new kind of competition, also involving science and technology, has been emerging—a peaceful struggle for superiority in world trade in which international prestige and solvency are at stake.

The dollar has enjoyed a special status for so long that to question its soundness is almost sacrilegious. Warning signs have been raised, however, by the gold drain and the deteriorating balance of payments. The recent revaluation of the German mark was an indication of the strength of that currency—and of the weakness of the dollar. Highly relevant to these monetary changes have been developments of special interest to science and technology.

The Changing Conditions of Competition

At one time our favorable balance of trade was based largely on shipments of agricultural products and raw materials. We still export wheat, tobacco, cotton, and other related items, but these exports are about counterbalanced by imports of coffee, tea, sugar, wine, and the like. Recently, our major exports have been in products that have been called research-intensive—that is, items involving sophisticated technology, such as electrical machinery, jet aircraft, computers, and chemicals. Our success in this competitive field in the early 1960's was such that our favorable balance of trade mounted to as much as $7 billion in 1964. This year our favorable balance of trade has almost disappeared. During the first six months it amounted to only $150 million.

Thus far the United States has not reacted very much to this change in our trading position. Part of our problem lies in an acute case of overconfidence that has lulled us into complacency. We win a race to the moon and conclude that we can do anything. We establish a long lead in computer technology and a few other conspicuous areas and forget that commercial competition is waged in terms of thousands of items in many markets. Part of our overconfidence is based on more than 20 years of industrial leadership. We are so accustomed to being on top that we forget that some of the factors that put us there have vanished.

In 1946 most of the industrial capacity of the world outside of the United States had been destroyed. Thus, we did not really win world leadership in international trade; it was thrust upon us. More than a decade elapsed before prewar capacities of other major countries were reestablished. During that period the United States moved ahead rapidly in science and technology and so remained in the lead. However, during the 1960's, western Europe and Japan narrowed the gap and in some fields of competition have overtaken us.

When faced with our changed ability to compete in foreign trade some economists display unconcern. They point to the fact that international trade accounts for only a small fraction of our gross national product.

Raw Materials in International Trade

But international trade is important, if only because it enables us to pay for crucially needed raw materials. We think of the United States as being very well supplied with raw materials, and this is to a degree true. The needs created by technology are many, however, and we are far from self-sufficient. Consider, for example, the important uses of stainless steels. These materials are employed in countless ways. A key component in these alloys is nickel. To meet our needs of this element we must import supplies to a value of more than $200 million a year. Another example, especially relevant to chemists, is our use of platinum-group metals. In 1968 we imported $121-million-worth of these substances. Other important elements of which we have never had an adequate supply include antimony, tin, and tungsten.

Another aspect of the raw-materials problem is that we are exhausting supplies of items in which earlier we were self-sufficient. At one time we were the world's leading exporter of petroleum and its products. Today we import more than $2-billion-worth annually. Recently the Federal Trade Commission commented on our diminishing reserves of natural gas. Almost simultaneously announcement was made of a plan to import large quantities of liquified natural gas from abroad. Another example of depletion is what is happening in copper. In the early part of this century we were the leading producer and exporter of copper. At that time the grade of ore mined was about 1.5 per cent copper. Today the average grade is 0.7 per cent, and we are a net importer. In 1968 the cost of such imports totaled more

than $500 million. This sum was extraordinarily large owing to a number of factors, such as the Vietnam war, strikes, and high prices, but even with the cessation of the war our costs for copper will remain high.

Increasing imports of raw materials must be paid for. This can be done from income on investments abroad, through international transfers of funds, through services, or through exports. In this article I will trace some of the evolution of our position in world trade, especially in products of high technology, mention underlying factors in our declining ability to compete, discuss briefly the hazards of excessive dependence on income from investments abroad, and finally, suggest some steps to meet the coming crisis.

The Growth of Technology Overseas

In the first years following World War II the United States was a substantial exporter of steel. Then during the 1950's the Austrians developed their basic oxygen furnace, a highly efficient means of converting pig iron into steel, which competes strongly with the open-hearth furnace. Because our steel industry had much open-hearth capacity, it was slow to adopt the basic oxygen furnace. Steelmakers in Japan and Germany were not so slow, and they became able to turn out steel more cheaply than we could. Today Japan imports much of its metallurgical coal from West Virginia and iron ore from Australia. Even so, its steel competes easily in the United States domestic market.

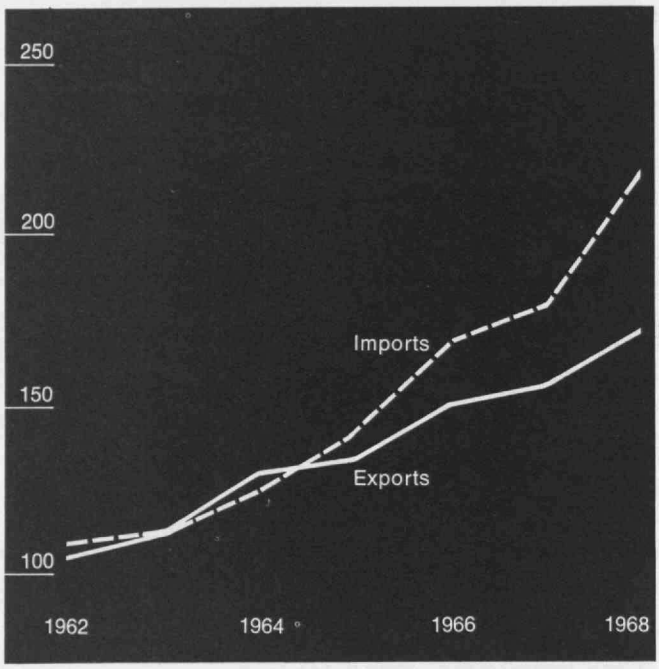
A nation like Japan that produces steel cheaply has a competitive advantage in products made from steel, such as machinery and ships. The Japanese have exploited this edge—for example in shipbuilding, in which they lead the world. This leadership gives them further advantages, since cheap marine transport is helpful to almost all aspects of international trade.

Traditionally the United States has been a leader in mass production, and we have come to regard ourselves as having an untouchable edge in it. Symbolic of mass production is the automobile industry. Unfortunately, what was once almost an American monopoly is not doing so well. As recently as 1965 the automotive industry was responsible for contributing nearly $1 billion to a favorable trade balance. Today, exports and imports are about equal.

Scientists are not particularly impressed with the science that goes into steelmaking. After all, man was making steel thousands of years ago. How goes the competition in areas in which great scientific and technical skill is involved?

The answer is not reassuring. Indeed, the serious competition we are facing in petrochemicals may be the principal cause of our major and increasing problem in maintaining international solvency. The record to date of the U.S. chemical industry has been one of which chemists can be proud. There has been a steady increase in chemistry's contribution to our international solvency. In 1968 exports of chemicals totaled more than $3 billion, whereas imports amounted to only about $1 billion. Chemistry was responsible in direct ways for

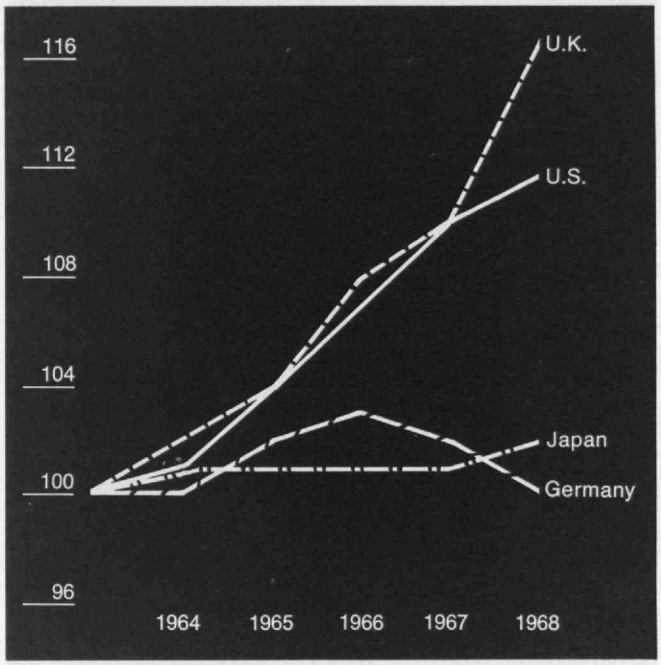
Since 1962, U.S. exports have grown at just over 8 per cent a year, while imports have grown at over 12 per cent a year. The result is a widening deficit in the U.S. balance of trade, a competition "in which international prestige and solvency are at stake," writes Dr. Abelson. (Data: Bureau of International Commerce, U.S. Department of Commerce)



a net favorable trade of more than $2.1 billion, and indirectly chemistry was of additional help in making possible other high technology. Without these substantial contributions the soundness of the dollar would indeed be questionable.

A recent article in *Chemical and Engineering News* by James G. Tewksbury provides evidence that should be of concern. He has focused on data concerning plant capacities for ethylene derivatives (ethylene is a key intermediate in the production of such major items as polyethylene, polyvinyl chloride, polystyrene, and ethylene glycol) in the United States and other countries, and he has analyzed trends in the foreign trade of these derivatives. The evolution in both plant capacities and foreign trade has been dramatic. In 1961 the U.S. capacity of 3 million metric tons (ethylene equivalents) was about ten times that of the European Economic Community; at that time Japan had no such plants. By 1965 U.S. capacity had risen to about 4.4 million tons, while that of E.E.C. had grown to 1.6 million tons and Japan was producing nearly 1 million tons. Even so, in 1965 both E.E.C. and Japan were net importers, and the United States enjoyed 95 per cent of the ethylene-derivative export trade. Today our share has dropped to 40 per cent; both E.E.C. and Japan have joined us as major ex-

The chart shows export price changes (index: 1963=100) of selected countries from 1963 to 1968. Internal conditions—including perhaps the increasing effectiveness of their technology—have combined to keep relatively constant the export prices of Japan and Germany, whose sales to the U.S. have been rising rapidly. Will full employment resulting from their success in world markets force the same inflationary conditions upon Germany and Japan which have affected U.S. and British prices? (Data: Bureau of International Commerce, U.S. Department of Commerce)



porters, and their total ethylene-derivative capacity is approaching that of the United States. Mr. Tewksbury is pessimistic about the future. He points out that European and Japanese ethylene capacity available for foreign trade is now expanding sharply and that further erosion of the trade position of the United States is virtually certain. He goes so far as to suggest that ultimately we may cease to be an exporter and become instead an importer of ethylene derivatives.

It seems likely that this sharp competition in chemicals will soon extend beyond ethylene derivatives. One need only extrapolate some historical trends to obtain a glimpse of the problem. In his book entitled *Japan Surges Ahead,* P. B. Stone has devoted a chapter to Japanese chemical industry. He points out that in 1958 production of petrochemicals totaled only about $30 million. In 1964 it amounted to nearly $700 million. During many years of the last decade Japan's expansion in petrochemicals has exceeded 50 per cent per year. Today that nation is the second-largest producer of petrochemicals. This enormous rate of growth has been accomplished on a very poor base of natural resources; Japan produces no petroleum and has little in the way of other raw materials. Growth of the petrochemical industry in Europe has not been so spectacular as in Japan, but it has been substantial and will provide additional sharp competition.

Electronics is another area in which sharp competition has emerged. A dramatic example was provided in a report in the September 8 issue of *Electronic News.* The article described the emergence of Japanese domination of the U.S. domestic market for electronic desk calculators. Three years ago, three American firms were major suppliers of desk calculators, manufacturing the mechanical variety. Last year only 7 per cent of calculators marketed were mechanical and the Japanese supplied 70 per cent of the electronic calculators.

Additional evidence can be drawn from the Overseas Business Reports of the United States Department of Commerce. Between 1963 and 1968 United States total exports increased from about $23.4 billion to $34.7 billion, roughly 50 per cent. During the same period imports of electrical apparatus from E.E.C. countries increased by 240 per cent and from Japan by 370 per cent. Imports of musical instruments and sound reproducers from Japan increased by 520 per cent, those of radio and television sets by 370 per cent.

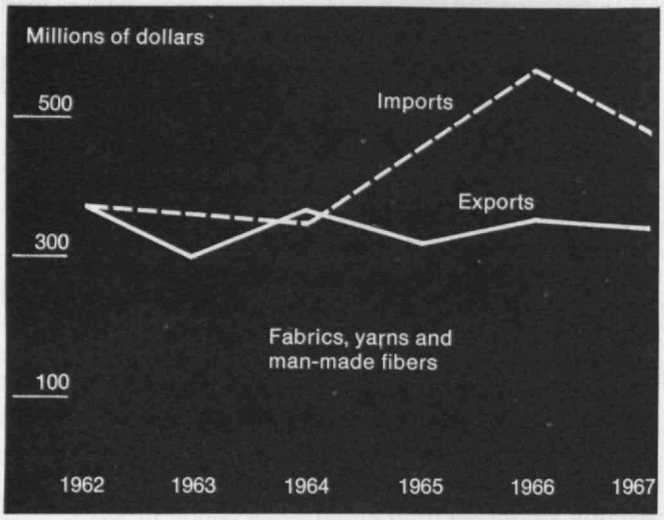
Nuclear Engineering as a Case in Point

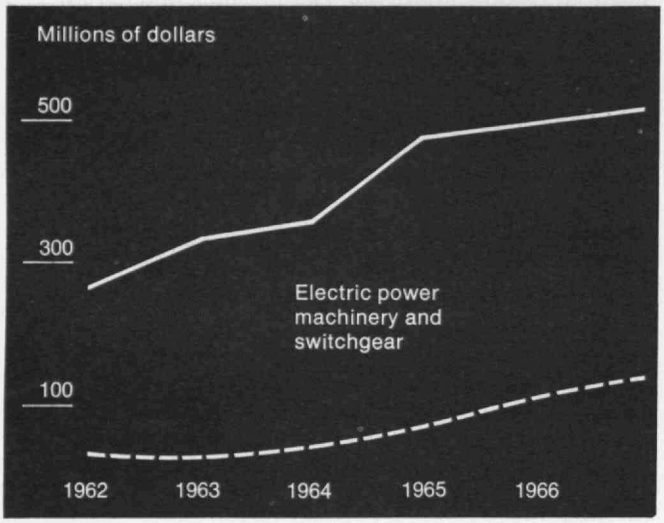
Another example of a major area in which we face increasing competition is atomic energy. For many years we were the leading pioneers in reactor development, and it would have been reasonable to expect that reactor exports might contribute heavily to a favorable balance of trade. Indeed we have already exported a number of reactors. However, trends do not look very favorable.

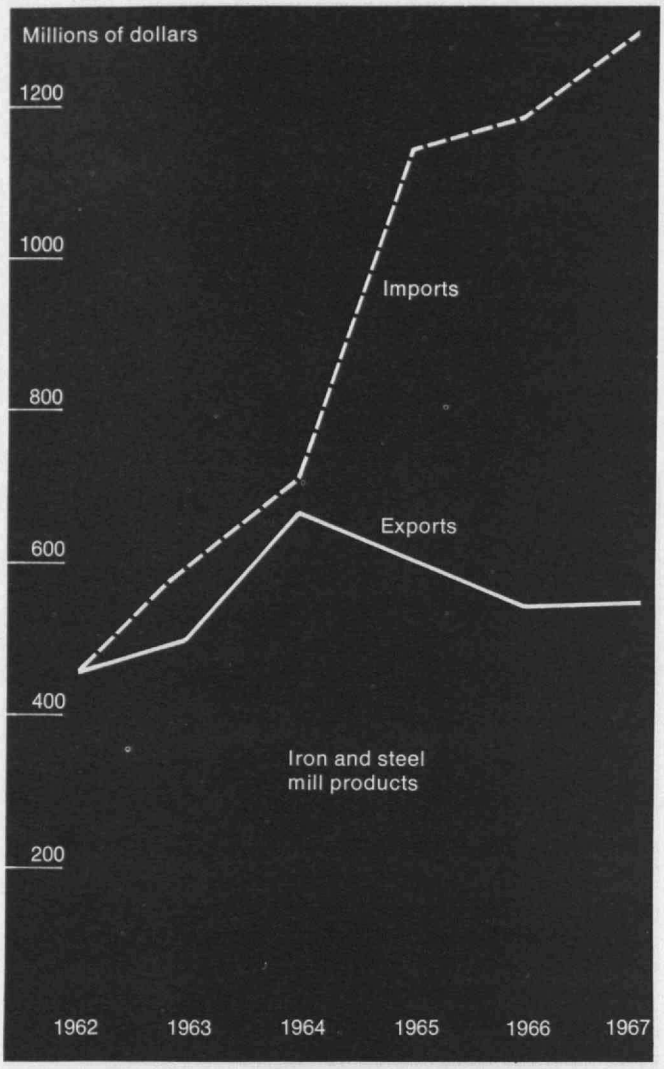
In 1963, when the order was placed for the nuclear plant at Oyster Creek, N.J., it appeared that the General Electric Co. had made a spectacular advance by designing a reactor that could compete with conventional fuels. Announcement of the award of the Oyster Creek nuclear plant set off a wave of optimism concerning nuclear power and led to a band-wagon rush by utilities to order large nuclear-powered generating stations. Soon a substantial backlog of orders built up.

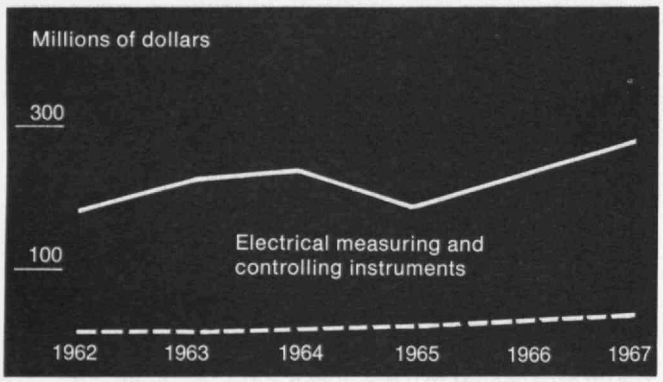
Then the troubles began. The Oyster Creek plant, which was slated for completion in 1967-68, has only recently begun operation. A prime cause of the delays was shoddy workmanship. When the reactor pressure vessel was tested in 1967, leaks were observed; detailed inspection then revealed more than 100 defective welds. Discovery of these defects alarmed those responsible for safety of the reactor, and extensive repairs were required. The net result was a long delay and a conspicuous black eye for the whole United States nuclear industry—this instead of the high repute that otherwise might well have been established. In addition, the incident induced extra caution. For these and other reasons, today many of the nuclear plants that have been authorized are behind schedule.

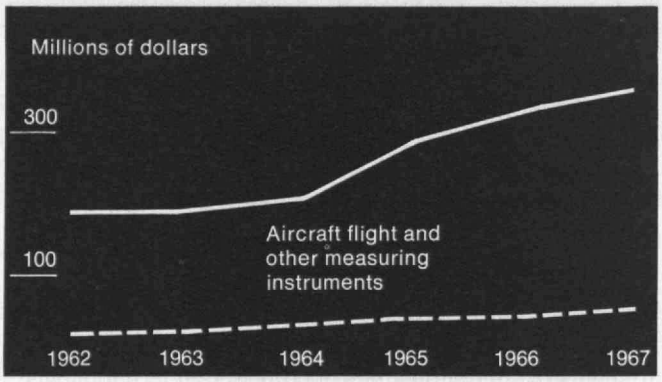
The consequences of this poor performance are made more serious by the emergence of foreign competition. Particularly impressive has been the record of West Germany. It was not until 1955 that the Germans were

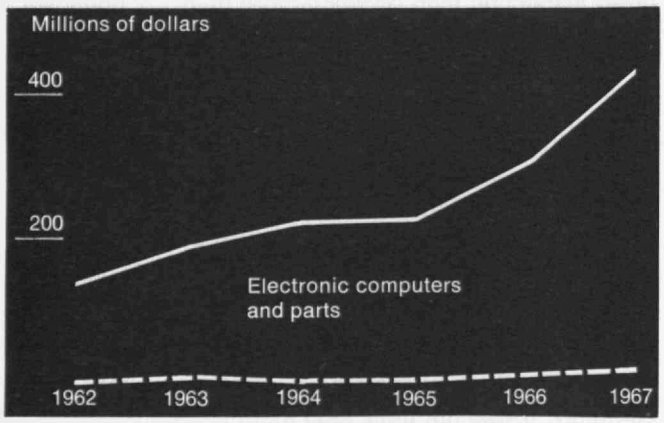

Millions of dollars
500
300
100
Imports
Exports
Fabrics, yarns and
man-made fibers
1962
1963
1964
1965
1966
1967

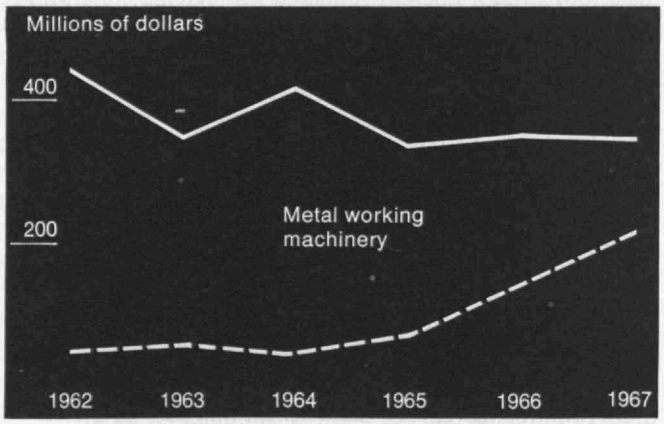

Millions of dollars
500
300
100
Electric power
machinery and
switchgear
1962
1963
1964
1965
1966


Millions of dollars
1200
1000
800
600
400
200
Imports
Exports
Iron and steel
mill products
1962
1963
1964
1965
1966
1967


Millions of dollars
300
100
Electrical measuring and
controlling instruments
1962
1963
1964
1965
1966
1967


Millions of dollars
300
100
Aircraft flight and
other measuring
instruments
1962
1963
1964
1965
1966
1967


Millions of dollars
400
200
Electronic computers
and parts
1962
1963
1964
1965
1966
1967


Millions of dollars
400
200
Metal working
machinery
1962
1963
1964
1965
1966
1967

Is the reduced competitive power of the products of United States technology in the world markets a visible symbol of invisible ills which plague U.S. innovation in science and engineering? The figures show the changing balance between U.S. exports and imports for seven key product groups between 1962 and 1967. (Data: Bureau of International Commerce, U.S. Department of Commerce)

permitted to engage in large-scale civilian nuclear development. Today they are fully competitive in many aspects of reactor development. Indeed, in nuclear propulsion of a merchant ship, the *Otto Hahn,* they have surpassed us.

At this time the United States leads quantitatively in the field of water-moderated reactors for production of electric power, but qualitatively our lead, if any, is narrow. In Germany generating facilities with a capacity of 900 megawatts are on line, two 600-megawatt plants are being constructed, and construction of a 1100-megawatt plant has been authorized. The three new installations are designed to compete economically with conventionally generated power. In the extremely important effort to develop sodium-cooled breeder reactors, the Germans are moving rapidly.

Recently I visited eleven major research laboratories or development facilities in Germany, including the Karlsruhe nuclear installation. The thoroughness with which engineering tasks are approached was most impressive. This care, coupled with traditional careful workmanship, makes it likely that German nuclear stations will perform as they are designed to perform, and it is doubtful that the Oyster Creek fiasco will be repeated in Germany. In consequence, our prospects for dominating the export market in reactors look slim.

A longer list of items and areas in which world leadership has passed or is passing from us could readily be developed, but the examples cited should suffice to indicate that we face a widespread set of serious problems.

The Sources of Our Discontent

Analysis of the causes of our diminishing ability to compete reveals that many factors are involved. To some degree industry, labor, and government all share responsibility, with the extent varying in different situations.

In his discussion of world trade in ethylene derivatives, Mr. Tewksbury mentions factors having a role in our diminished competitiveness in petrochemicals. One of these is the American attitude toward export trade. The Europeans and Japanese are export-oriented and will sacrifice domestic business to obtain foreign sales. The opposite is true here. Moreover, the European and Japanese governments act to encourage exports through incentives and discourage imports through tariffs. Tewksbury further states that the current so-called Kennedy round of tariff reductions is injuring the relative position of U.S. chemical industry. Another governmental policy that has imposed a handicap is our oil import policy, which artificially supports U.S. feedstock prices far above world levels. Thus the Japanese, obtaining their oil from the Persian Gulf, pay less for it in Japan than a U.S. chemical company would pay to buy oil in Texas.

Important in all aspects of competition with other countries is our high labor cost. A few years ago this disadvantage and others were more than counterbalanced by much larger plants and more advanced technology. Now, says Mr. Tewksbury, the domestic chemical industry no longer enjoys these advantages. Foreign plants and companies are large enough to enjoy economies of scale, and technology is fully disseminated.

Foreign Investments and National Policy

In our readiness to disseminate our technology we were guilty of an error in judgment. We underestimated how effectively our competitors would exploit and improve on our methods. The Japanese obtained most of their technology from us and then improved on it in clever ways. We have permitted, even encouraged, the establishment of subsidiaries in Europe. They have exploited technology developed by the parent companies and now produce many goods that compete with U.S. products.

In conversations with Germans during my recent European visit I found what appears to be another important factor in the relationship there between government and industry. In Germany a very cooperative attitude exists between the two, and government acts as a friend rather than an enemy of industry. To foster commercial exploitation of atomic energy, the German government provided much of the development funds required by German industry, but—except for shop rights—it permitted patents to accrue to the companies. This is, of course, in contrast to the United States, where ridiculous interference with patent rights has occurred when only a tiny portion of the support could be construed to have come from the government. In his book on Japan, Mr. Stone also describes very close working relations there between industry and government.

One of the great advantages enjoyed by Japan and Germany is a freedom from the necessity to spend huge sums for defense; that burden falls largely on us. With military expansion denied to them, they have channeled their energies to commercial competition. Both the Japanese and the Germans are determined to be outstanding in the world, and economic development is currently the most feasible route. How can the United States, which is in some sense lethargic and without a sense of direction, compete with such energetic people, especially when we do not recognize that we are in a contest?

I have voiced some of my concerns about diminishing competitiveness to a few economists. They have expressed sympathy, but they point to our growing income from foreign investments. Recent experience should alert us to the danger of depending too much on such income. Foreign governments can and do confiscate investments in a variety of ways. They can issue regulations banning transfer of earnings to the United States. They can raise taxes to such an extent that in effect they expropriate earnings. They can also resort to the cruder technique of outright expropriation. In some instances this may be stepwise, in others in one move. Refusal to allow repatriation of earnings has long been employed by Japan. Earnings from oil investments in Venezuela and the Middle East have been increasingly diverted to the respective foreign governments by taxes and other regulations. In the last few months stepwise expropriation has been employed by Chile and Zambia, the two big foreign copper producers. Peru has recently expropriated substantial foreign land and refinery holdings.

The action by Chile and Zambia will have a double effect on the United States. Income will be lost to U.S. companies, and the price of copper to the United States will increase as the governments seek to squeeze more revenue out of their resources. Indeed, as the United States becomes more dependent on foreign sources for raw materials, it becomes more at the mercy of those sources' pricing policies and costs are likely to shoot upward.

It is thus poor policy to depend excessively on either foreign investment income or supplies of scarce materials from abroad. We need to maintain a reasonable balance between imports and exports, and we should avoid a substantial dependence on any one supplier for our needs of materials.

Innovation: To Accentuate the Positive

When one looks at the liabilities of the United States in competing with Japan and Germany, it is possible to recognize many ways in which we are at a disadvantage. Among the most important are the burden of defense, high labor costs, poor attitude of government toward industry, and failure of government to set realistic national goals in areas where science and technology are important.

We have two major assets that we have failed to utilize as effectively as we might—namely, an excellent capacity for innovation and great natural resources.

Our capacity for innovation has been demonstrated repeatedly. It rests on many factors, including excellence in science. During the last few years, however, this nation has been neither vigorous nor wise in its program for fostering its intellectual resources. As an example, there has been a failure to recognize the central importance of chemistry in meeting society's needs and in the advancement of the scientific enterprise generally. It should be obvious that government policy has been niggardly in support of chemistry while billions have been lavished on space. Had 1 per cent of the funds for space—which would never have been missed—been diverted to chemistry, our situation today might be quite different.

The losses from failure to support chemistry were twofold: we did not advance knowledge in the field so fast and we did not attract and train a proper fraction of the brightest young men. When the government glamorizes an area it channels many of the best young minds in the direction of that field; glamour is perhaps more important to the young than money. Yet it is not so much that the young are interested in glamour as such. Rather, all of us want desperately to be part of something that is highly significant. If gifted young men could realize the changed nature of the American position in this world, many would be eager to devote their talents to meeting the new challenges.

One way of channeling ingenuity into innovation would be to make the United States less dependent on foreign sources of raw materials. Such a program would entail development of new extractive methods, invention of substitutes, and reprocessing of discarded wastes.

Today we are on a course that will lead to loss of international prestige and to monetary problems. We need not reach such a destination. Many actions can be taken. It is essential that we recognize the existence of the danger, however, and begin to take constructive measures.

Philip H. Abelson was trained in chemistry at Washington State College, and received his Ph.D. in nuclear physics at the University of California. He served as a physicist in the Naval Research Laboratory (1941-1946) before becoming Chairman of the Biophysics Section and later Director of the Geophysical Laboratory (1953) at the Carnegie Institution of Washington. He has had many consulting and committee assignments for government and professional societies, and as its Editor (since 1962) he has brought new life and distinction to Science, *the weekly magazine of the American Association for the Advancement of Science. This essay is adapted from a talk given by Dr. Abelson at a Symposium on the Relationship of Science and Society at the 158th national meeting of the American Chemical Society in New York in September, 1969.*

Trend of Affairs

Enzymatic and Other Properties for Glass

Glass is not as completely inert, chemically, as is often thought. Chemical and biochemical reactions are observable at its surface—most notably, glass has the property of hastening the clotting of blood. But such phenomena have been generally regarded as minor disadvantages of an otherwise remarkably useful substance.

But in recent years, glass manufacturers searching for new applications for their product have been following a fascinating trail, which started with chemical modifications of the glass surface and has now led them to the commercial enzyme business. Successive discoveries at the Corning Glass Works were described at an M.I.T. Ceramics Seminar in November by Dr. Jack Hutchins, an M.I.T. alumnus who is now in charge of Corning's Bio-Organic Technology Group.

For many years, an intermediate in one of Corning's manufacturing processes has been a porous form of sodium borosilicate glass. In itself, this porous glass had no uses, but it was found possible to make the pores remarkably uniform, suggesting that the material might be useful as a filter for the separation of high-molecular-weight substances.

One possibility was that it might be used for membranes in artificial kidneys. Indeed, this porous glass promised to be extraordinarily efficient, were it not for the well-known clotting effect.

At the same time, it was known that the surface chemistry of such a glass can be changed by reacting its exposed hydroxyl (OH) groups with silanes (compounds similar to hydrocarbons, with silicon replacing the carbon). And a suitable silane was found, resulting in an amine-surfaced glass that did not cause blood to coagulate. But the clotting effect is so well established that Corning balked at the magnitude of the effort necessary to convince the medical profession it had been overcome. Besides, there were other ideas to research.

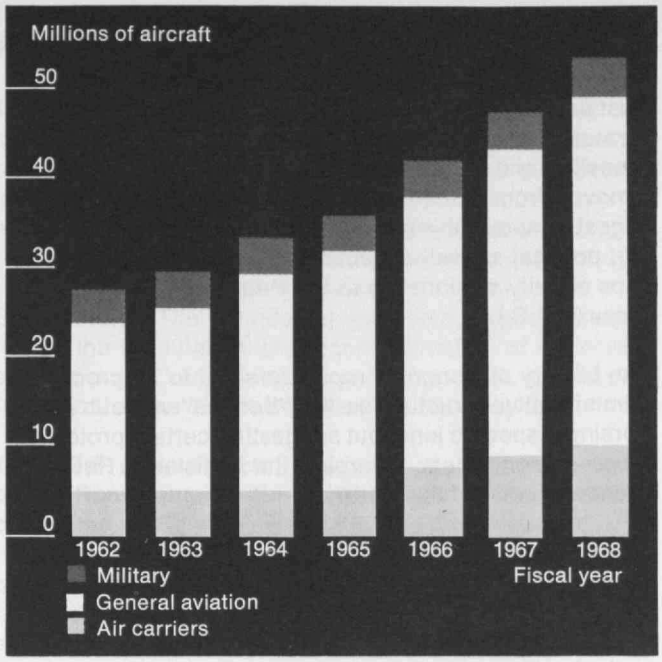
The attempt to filter albumin through the porous glass led to a strange observation: the albumin disappeared from one side of the glass filter but did not reappear at the other. Dr. Hutchins said nothing of where the albumin disappeared to, but instead told his audience that the *rate* at which this and other macromolecules disappeared proved to be related to their molecular weight, in a simple linear fashion. So the porous glass is now being tried out as a molecular-weight meter.

The chemical entities that can be attached to a glass surface are not restricted to such simple groups as methyl and the amines. Whole enzymes can be adsorbed. Starting with RNAse (an enzyme which catalyses changes in the genetic protein RNA) it was discovered that at least some enzymes could be attached to glass without losing their catalytic activity. Indeed, the attachment actually preserved the protein-breaking enzymes—themselves proteins—from the spontaneous degradation which occurs in solution. At first, certain enzymes lost their activity when adsorbed onto glass. The reason, it transpired, was that in such cases the part of the molecule responsible for its activity was being used to connect it to the glass. By pre-coating the glass with some "linking" group it was invariably found possible to induce the enzyme to stick in some other position, leaving the active site free.

Enzymes are currently finding many commercial uses: about $60-million-worth annually in cleaning agents and $50 million in other applications, said Dr. Hutchins. Adsorption on glass confers remarkable shelf-life and efficiency. Papain, one of the enzymes which break down proteins (which is how the domestic enzymatic cleaning agents work) has been stored effectively for two months without refrigeration, whereas such enzymes ordinarily have to be cooled to retard the mutual destruction of their molecules. In one experiment the same enzyme, again on glass, acted at an undiminished rate for 90 minutes—in that time breaking down 5,000 times its own weight of protein.

Possible applications include the conversion of organic waste materials and the transformation of inedible forms of protein into edible forms. (Dr. Hutchins mentioned one researcher—not using the glass-coating approach—who has succeeded in enzymatically obtaining a substance "looking like whipped cream" from chicken feathers.)

There are also medical possibilities. For example, one



Recent growth in the three sectors of U.S. aviation, as measured in operations at airports having Federal Aviation Authority control towers. This picture includes most of the airline traffic, very little of the military, and only 20 to 25 per cent of the burgeoning "general" or "private" sector, according to Gilbert F. Quinby of NARCO Avionics (from a paper presented to the 1969 Northeast Electronics Research and Engineering Meeting).

form of leukemia could apparently be treated by using an enzyme called L-asparaginase to remove from the bloodstream a nutrient on which the diseased cells depend (normal cells remaining unaffected, since they manufacture the nutrient themselves). Unfortunately, the enzyme is expensive, and the body's defenses destroy it. Both these obstacles might be overcome by shunting blood out of the body, over a glass surface coated with L-asparaginase, and back. So far, this technique has been tried on a dog, with some success. Other co-operative research between Corning and various medical teams is being planned.

Warding Off Future Mid-Air Collisions

Broadly speaking, there are three main categories of aircraft—military, commercial carriers, and "private," which includes everything else. The fastest growth is in the private sector. Present trends imply that by 1995 there may be 100,000 aircraft in the air over the U.S. at any given moment, carrying perhaps a million people simultaneously. The great majority of these will be private aircraft.

From first principles, the frequency of collisions between objects in a given space is proportional to the square of the number of objects. In 1980, there are likely to be nine collisions between airliners and private aircraft, and 119 between private aircraft and each other. In 1985, the figures become 41 and 792, respectively.

These estimates were given by General J. Francis Taylor in an informal appearance at a session on air traffic control during the Northeast Electronics Research and Engineering Meeting in Boston in November. General Taylor is a member of the Alexander Committee on Air Traffic Control, whose findings have been submitted to the Department of Transportation but have not been published. He is President of Aeronautical Radio Incorporated, a company owned jointly by the airlines, which produces specifications for aviation radio equipment.

General Taylor gave a brief outline of the Committee's findings. One general point is that any scheme seriously proposed must be such that "we can get there from here." That is, systems bearing little relation to current equipment or economic limitations are of academic interest only. In this, General Taylor mildly echoed the "hard-headed realist" approach of Gilbert F. Quinby of NARCO Avionics (the biggest supplier of navigation equipment to private aviation) who showed little respect for any ideas which the plane-owner is unlikely to want to buy.

In practice, this means building on the basis of the capabilities known as visual omnidirectional range (V.O.R.) and distance measuring equipment (D.M.E.). The NARCO estimate is that, of the 125,000 private aircraft flying today, 106,000 are equipped with V.O.R., which is a very-high-frequency navigation facility, and 27,000 with the airborne end of the D.M.E. system, whereby a traffic controller on the ground can estimate the position of an identifiable aircraft.

The second of the Alexander Committee's guidelines again looks fairly predictable at first sight—that airports must be used more efficiently in terms of how many aircraft a runway handles per unit time. Without going into details, General Taylor said that it was now possible to reduce the minimum interval between aircraft below the present limit, set by the necessity for each aircraft to keep out of the wake of the one ahead.

As regards instrument-controlled landings, a new system is available which uses, instead of a fixed guide-beam, a microwave beam which scans through 60°. This allows a choice of approaches. One benefit here is that the public nuisance of aircraft noise in built-up areas can be reduced somewhat, given greater freedom of flight-path.

Instrument-controlled landing, General Taylor went on, could in principle be automated, easing the traffic-control task considerably—provided that every aircaft, without exception, carries a radio "beacon" whereby its position can be established without human intervention. Hitherto there has been something of an economic

barrier here, but now an adequate beacon can be fitted for as little as $200. It would provide a data-link between ground and air which would be used intermittently, as and when the control system on the ground requires information about a particular aircraft. This is a key concept for the future, said General Taylor.

Of course, the dream of the private flyer remains what it has always been: to take off at any time, from anywhere, fly a course of his own choosing, land anywhere, and walk away. Mr. Quinby spoke of the current movement towards dividing airspace into two classes, premium and public. The former is airspace which is consistently subjected to a demand above its capacity. Here the airliners and military aircraft operate, traffic control systems become increasingly expensive, and to get in at all a user has to pay an appropriate fee and satisfy certain minimum technical standards (which are even now being worked out by the Radio Technical Commission for Aeronautics and the Federal Aviation Agency). Public airspace, in contrast, would allow considerable freedom and cost less in fees and equipment in return for a rather different degree of risk.

Assessing Assessment

Having received the three reports on technology assessment he asked for, Rep. Emilio Q. Daddario, Chairman of the House Subcommittee on Science, Research, and Development, has now concluded a series of hearings from which is likely to emerge a decision on the kind of administrative structure best designed to help Congress reach sound judgments about supporting particular technological projects. Reports were prepared by (1) the Science Policy Research Division, Legislative Reference Service, Library of Congress (L.C.) (*see* Technology Review *for June 1969, pp. 8-9*); (2) the National Academy of Sciences (N.A.S.); and (3) the National Academy of Engineering (N.A.E.)

Not surprisingly, the reports are in basic agreement. Each recognized the obvious problems: despoliation of the environment; incomplete staff work—notably with reference to the supersonic transport airplane and its unanticipated menace of sonic boom; the hazards of antiseptics to humans as well as animals; and the rest of the too-long category of unwisdom in hurrying technological implementation. Each agreed that something must be done, and generally, on the kind of apparatus that should manage the assessment task: responsible and responsive to the Congress; impartial—removed from immediate identification with, but knowledgeable about, the proposed technological undertaking; political as well as technological savvy (L.C.); perhaps equally responsible to the President as to Congress (N.A.S.).

The Library of Congress report referred to its proposed administrative structure as the "Service" without endorsing a specific kind, but suggesting certain prototypes—among them, enlarging the Legislative Reference Service of the Library.

The N.A.S. called its structure "a constellation of organizations, with components located strategically within both political branches, that can create a focus for and a forum for responsible technology assessment activities throughout government and the private sector." The N.A.E. identified its administrative machinery as a "management organization, controlled by and answering to the Congress, arranging for the preparation of technology assessments for congressional purposes." It would contract for, administer, and organize assessment task forces.

The N.A.E. felt that the assessment of a particular technology should be the sole mission of a small *ad hoc* task force, which should complete its work in about one year in an environment free of political influence and bias.

Procedure followed by the three institutions in gathering substance for their reports differed significantly. Dr. Harvey Brooks, Dean of Engineering and Applied Physics at Harvard University, who was Chairman of the N.A.S. committee, reported that his *ad hoc* panel thought it might follow a case-study method but abandoned that approach as "impractical. . . . The problems of technological impact are so diverse, the variety of technologies so great, that it proved impossible to find a reasonable number of cases that could be said to be truly representative of the problem." Such an "impossible" situation seemed not at all to disturb the L.C. group which based its findings largely on studies of 14 separate cases. The N.A.E. report, as well, examined three cases very carefully—the technology of hearing aids, subsonic aircraft noise, and multiphasic health screening.

The reports served Mr. Daddario well as a runway from which to lift off the hearings held late last year. He did not seek testimony from any of the men who worked on the original reports. Rather, he called in scientists, engineers, and other experts in the areas under consideration for a critical examination of the proposals before his Subcommittee. Some time will elapse before decisions are reached, but the administrative structure ultimately chosen will reflect the kind of thoroughgoing analysis and evaluation that has come to be the hallmark of the work of the House Subcommittee on Science, Research, and Development.—*Clyde C. Hall*

A New Role for N.S.F.

The National Science Foundation, whose role in just over 20 years has been mostly to pass out federal resources to scientists on the basis of their own proposals, is changing its strategy. In recent Congressional testimony, William D. McElroy, the Foundation's Director, reported that the N.S.F. is starting a new program of "Interdisciplinary Research Relevant to Problems of Our Society." The Foundation will "take a more active role in the formulation and recommendation of national science policy" and "actively seek proposals, especially for critical areas of investigation," Dr. McElroy said.

The N.S.F.'s new Director was on Capitol Hill to testify before Representative Emilio Q. Daddario's House Subcommittee on Science, Research and Development, which has received three major reports on the problem of predicting (and weighing) the benefits and hazards of new technology. The Science Foundation's new interdisciplinary program is a response to this evaluation problem: "If technological assessment is to be responsive to the secondary, tertiary, and higher orders of consequence of a given technology, then research in massive proportions will be required to support it," said Dr. McElroy.

"In particular," he said, "the N.S.F. must exercise a significant role in identifying specific ways in which scientific research can contribute to efforts to cope with such major societal problems as environmental quality, urbanization, and transportation, and to the international relationships of the U.S." And, said Dr. McElroy, where the magnitude of an emergency is great enough, or the traditional disciplinary structure of academic departments is limited, the Foundation may find it must "initiate and establish new research centers to handle the problems that emerge from technological assessments."

Philip Yaeger, perceptive counsel for the Daddario Subcommittee, raised his eyebrows. "Your testimony suggests a big change in the direction of N.S.F., Dr. McElroy," he said. "Aren't you likely to suffer a few labor pains down there?

"And what will be the reaction to 'pure' scientists?" asked Mr. Yaeger. Dr. McElroy moved quickly to assure him: "We can't let go of our solid-base support of basic science, of course," he replied. And, he said, "we are quite aware of the sensitivity we may encounter among scientists." But a "major concern . . . of the N.S.F. staff as a whole can and must be technology assessment."—*Clyde C. Hall*

Cyclamates and Cotton Candy

The decision of the Department of Health, Education and Welfare, in October, to remove cyclamate artificial sweeteners from the market was quickly followed by similar decisions in many other countries, including Britain. Less than two weeks after the U.S. decision, the British Minister of Agriculture announced that cyclamates would be phased out by January 1, 1970, on the basis of the U.S. evidence.

Nature (Vol. 224, pp. 398-399) quotes a Ministry spokesman as explaining, "Public opinion wanted an answer straight away. We'd have been caught very much with our head in the sand if we didn't do anything about the cyclamates. We had either to ban them or prove them harmless."

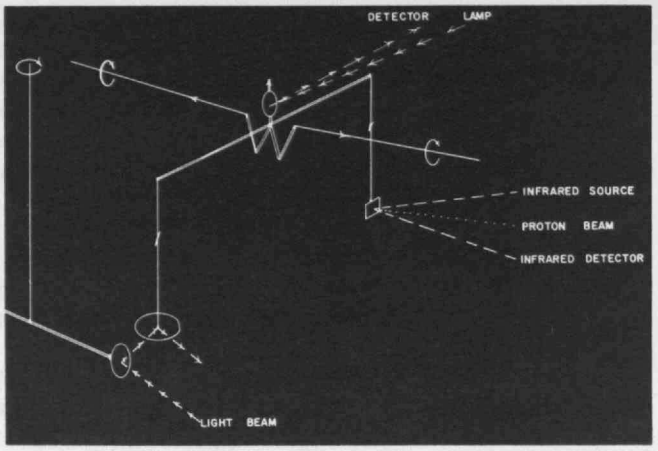
"Even the fleet-footed Ministry of Agriculture," *Nature* comments, "could not prove cyclamates harmless at seven days' notice." What the Ministry did was to send for the American test results and pass them to the Food Additives and Contaminants Committee and its subcommittee on Pharmacology.

In essence, 12 rats had been fed throughout their lives a diet containing a mixture of cyclamate and saccharine, such as is often used commercially, which gave the animals 2.5 g. of cyclamate per day per kilogram of body weight. This is 50 times the dosage recommended for humans at that time. Six of the rats developed bladder cancers. Since there was no specific evidence against saccharine, which has been in use for very much longer than the 15 years cyclamates have been on the U.S. market (5 years in Britain) the decision was reached, in the U.S., that cyclamates can cause cancer. *Nature,* pointing out that the cancers might also have been due to both components of the mixture acting co-operatively, describes the evidence as "about as solid as candyfloss," which is the English word for cotton candy.

The British committees recommended to the Minister that there should be no further addition of cyclamates to food until results were available from a study then going on at the British Industrial Biological Research Association. In fact, the Minister issued a ban on cy-

(Right) A microbalance of which the restoring force is the radiation pressure of a light beam. As the light pressure on the left-hand side of the main balance is altered, it is registered by the torsion balance on the left.

(Far right) Photograph gives an idea of the delicacy of the system, which weighs to within 10^{-8}g. in the immediate vicinity of a powerful vacuum pump.



clamates, while admitting, according to the *New York Times,* that "we see no cause for alarm. There is no evidence whatsoever that cyclamates have caused cancer in humans."

The *Nature* article concludes: "It only remained for housewives to be soothed with advice as to what foods and beverages were likely to contain the deadly substance before a grateful public could sink back, probably to soothe itself with a well-earned cigarette, confident in the knowledge that its political and scientific guardians would leave no stone unturned to protect the nation's health, save any such as might be inconveniently heavy to uproot."

Meanwhile, back in the U.S., cyclamates began to give place to saccharine. For example, Royal Crown Cola had been working on replacing the cyclamates in its "Diet Rite" cola with saccharine for "a number of months," its president was quoted as saying.

In a later issue of *Nature (Vol. 224, p. 734),* Dr. Joshua Lederberg, of the Stanford University School of Medicine, wrote of the need "to delineate the kinds of testing that should govern the approval of a proposed food additive," and went on: "The fact that saccharine has been in use for fifteen years has very little relevance to the possibility of chronic hazards from it." Dr. Lederberg continued: "As far as I know, there have been no systematic epidemiological studies that could sort out the possible benefits or conceivable hazards of saccharine."

Others who are unconvinced by the evidence against cyclamates include Stanley L. Inhorn and Lorraine F. Meisner, of the State Laboratory of Hygiene at the University of Wisconsin, whose experiments with the sweetener have revealed some degree of teratogenesis (deformity production) in chicks, but not in rats, and "no mutagenic effect when very high concentrations of cyclamate were put into cultures of normal human cells." Listing the benefits of cyclamate (*Science,* November 7, 1969, p. 685), they "find it inconceivable that . . . cyclamate may be discarded on the basis of experiments employing only 12 rats. We can see," they add, "no other explanation for this hasty action on the part of the F.D.A. and Secretary of Health, Education and Welfare except that political or economic pressure caused them to bypass the established scientific evaluation procedure."

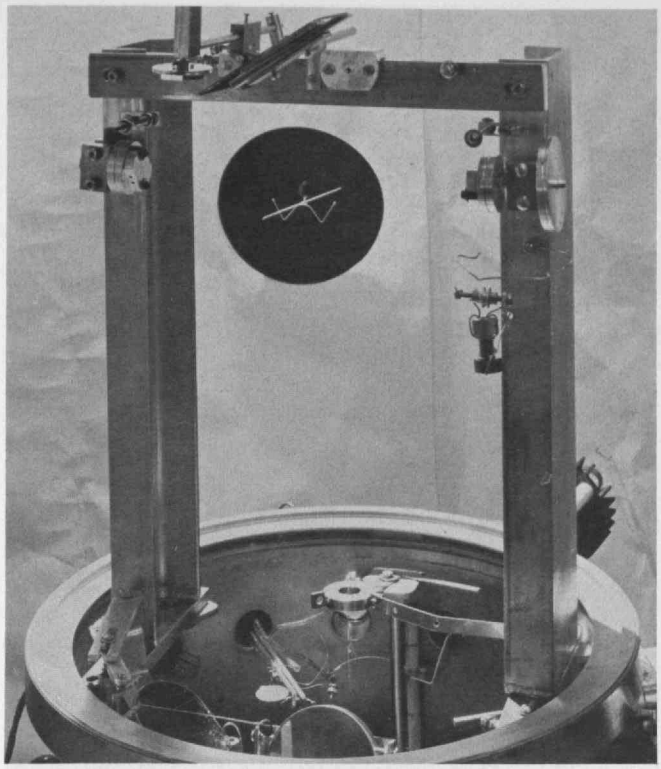
Lightweight Balance Weighted With Light

In any weighing device, the weight of the sample must be counteracted by some other force. This opposing force may be provided, for example, by another weight, or a spring, or an electromagnetic system. Hitherto, no one has used the pressure of light for this purpose. Credit for being the first is claimed by Karl P. Zinnow and Jens P. Dybwad of the Air Force Cambridge Research Laboratories, Bedford, Massachusetts.

In connection with infrared studies of silicates bombarded with protons, Drs. Zinnow and Dybwad found it necessary to measure the retention of hydrogen by the bombarded material and the adsorption of gas at its surface. This meant measuring weight changes to an accuracy of about 10^{-8}g. Ordinarily, a balance for this purpose would rely on magnetic forces, but the experiment had to be done at a pressure of 10^{-11} torr and thus in the vicinity of a 500 liter/sec. vacuum pump which generates a considerable magnetic field.

The researchers realized that a force of the right order could be supplied by a light beam. The pressure of sunlight on a mirror is about 10^{-7} g/sq.cm., and the same effect can be achieved with a 30-watt lamp. The system they devised, shown in the diagram, does not actually entail measuring light-power as such. The light beam whose force counteracts the weight-changes shines equally on a secondary balance, where the force can be measured at a torsion wire.

The system is not quite as simple as this, in fact. The light beam is pulsed, which keeps the glass balance arm swinging at about one swing per minute. A detector, using the balance-arm's central mirror, registers the times at which the balance passes through its null position. As the weight of the sample changes, times between successive null-crossings become unequal. The inequality is made to initiate a change in the intensity of the light beam, such that the balance is restored to equilibrium—that is, such that null-crossings again occur at equal intervals. The changed light-intensity causes the torsion-balance arm to rotate (by about 4° per 10^{-8}g.), and in returning it to its original position the weight change is read out at the torsion-head.



The total weight of the balance, including the sample at one end and the horizontal mirror at the other (suspended on tungsten wires), is about 1.2 g., and the instrument can measure weight changes of 40×10^{-8}g. with a sensitivity of better than 10^{-8}g. The rather limited range is dictated by the range of linearity of the light source (a 650-watt quartz-iodine lamp operated at very low power). The range can be shifted by changing the zero setting of the torsion wire and the sensitivity by torsion of the horizontal wire which carries the balance's fulcrum.

Bioengineering Needs

How can engineering schools respond to "pressing national needs in biomedical engineering?"

Some 29 universities replied to the question with proposals for education and research when asked by the National Academy of Engineering in 1967, and six of these proposals were accepted by N.A.E. for subcontract support so that prototype planning could proceed. Now N.A.E. has collected these further studies into a compilation of universities' judgments on the sharpest of the issues confronting those who would intensify the role of engineering in the nature and delivery of medical care.

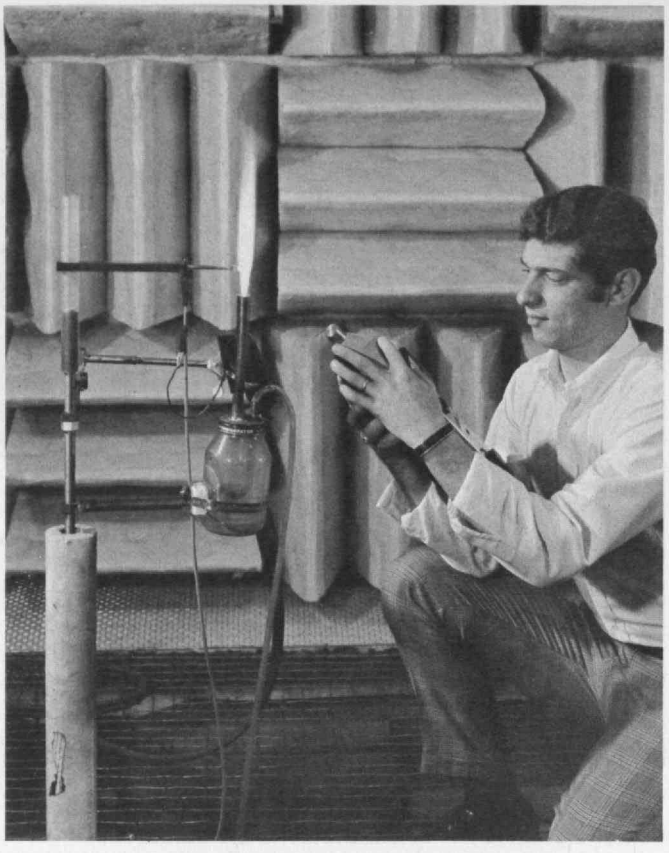
The result is a set of eight key questions (and suggestions for their solution) which indicate the central issues as seen by the N.A.E. and six leading academic communities.

1. How can the medical community become more receptive to advances stemming from technology? The suggestions centered on new organizations to bring doctors, hospitals, and engineers together.
2. How adequate are present programs to train bioengineers for medical service, and doctors in physical and engineering? The response: what is now being done is adequate as to quality but not quantity, and additional financial support is needed.
3. Can industry be encouraged to produce low-cost and reliable components and systems based on new technology? Yes, through the same organizations developed in response to the first question.
4. What can technology contribute to reducing health care costs? Bring new expertise in management to bear.
5. What greater incentives can be given to engineers for collaborating with the medical professions? No specific suggestions were made.
6. Are there "imaginative and practical" new methods for communicating engineering research results to doctors? The new organizations proposed in response to the first question will serve, and the joint M.I.T.-Harvard group (one of the six subcontracting organizations) also suggested a special agency to provide an information service to medical centers and industry.
7. Can "innovative, improved" methods for incorporating medical information into engineering curricula be devised? Departmental or interdepartmental academic units in bioengineering were proposed in most studies.
8. What are the identifiable career paths and rewards for biomedical engineering students? No clear route or traditions were reported.

As a result, the National Academy of Engineering told the National Institutes of Health that to assure effective campus development of biomedical engineering, there must be support for traditional training programs, for extensive new course development programs, for a new research area in medical instrumentation and systems, and for multidisciplinary work in hospital design, health care planning, and community environmental problems. The N.A.E. committee promised to suggest "realistic estimates of the funding required" in a future report.

In addition to a joint activity of M.I.T. and the Harvard Medical School, the six groups developing prototype plans for the N.A.E. included Carnegie-Mellon University (in association with two Pittsburgh hospitals), Johns Hopkins University, Ohio State University, and the Universities of Virginia and Washington.

Michael Oslac, research assistant at Pennsylvania State University, sprays potassium chloride solution into a simulated jet-engine flame, turning it into a kind of loudspeaker: the flame emits sounds when an audio-frequency voltage is applied across it.



Patent Policy vs. Medical Innovation

Though the group was a subcommittee of the National Academy of Engineering's study of the interplay of engineering with biology and medicine, the subject was U.S. patent policy.

Murray Eden, Professor Electrical Engineering at M.I.T. who is Chairman of the Subcommittee on Interaction with Industry, explained in his opening statement to an N.A.E.-sponsored meeting in Washington this fall: his group found little enthusiasm among manufacturers to produce biomedical instruments and other medical devices, due largely to uncertainties in the patent protection on devices they might develop under federal sponsorship. Hence the effort to bring all parties together to clear out the road blocks. As it turned out, the differences were (and remain) fundamental.

Manuel B. Hiller, patent attorney for the Department of Health, Education and Welfare, described H.E.W.'s "institutional agreement" arrangement, under whose terms patents held by universities on products developed under federal grants may be licensed, non-exclusively or exclusively, to private contractors for exploitation for public benefit. Harry L. Baker, Jr., Director of Research Administration at Georgia Institute of Technology, spoke in support of this policy: universities need incentives for their own research people, and these would be lost if patents rights were extended to any agency, public or private, without some degree of financial participation.

In contrast, Richard Holmes of Smith, Kline and French told his listeners bluntly that if his firm were asked to develop pharmaceutical compounds under federal support, for example, it would want exclusive patent rights to products resulting from its development work for a period longer than the currently allowed three years.

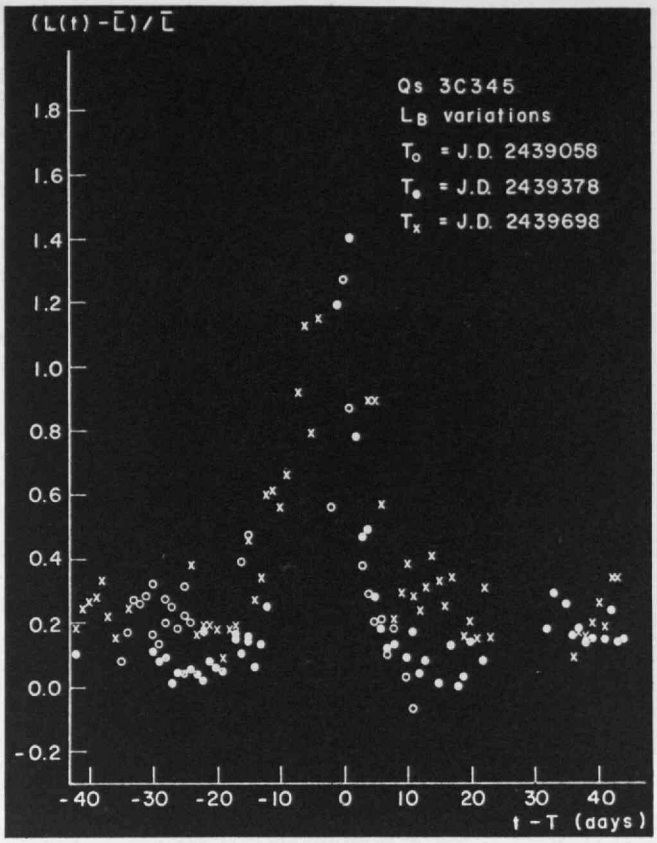
"Industry must be given exclusivity and longer marketing time to recoup the tremendous developmental costs and to realize reasonable profits," Mr. Holmes said.

In response, Professor Eden speculated that "perhaps we in the universities should take more of an entrepreneurial attitude toward our work. But I hope university research will never be clouded by a philosophy of 'maybe there's money in this for me,' " he said.

By the end of the day, Professor Eden was forced to conclude that "there is no one-shot solution for our problem—no single policy that can be uniform for everyone. Exclusive patent rights and a longer-than-three-year-period of exclusivity may be important for the drug industry; I'm not so sure it is for us who are concerned with biomedical instrumentation," he said. Yet despite the obvious differences in point of view, Professor Eden proposed that "common sense will prevail among men of good will, and jointly we will be able to agree on a flexible and viable patent policy."—*Clyde C. Hall*

Making a Jet Flame Sing For Silence

It is well enough known that, under certain conditions, a flame can be made to emit a musical tone. Less well known is the fact that a high-velocity flame, simulating the exhaust of a jet engine, can be caused to sing in a controllable fashion by electrical means. Gerhard Reethof, who is Alcoa Professor of Mechanical Engineering at Pennsylvania State University, thinks that in this way it may be possible to cancel out the noise from the fan of a fan-jet—one of the more obdurate components of jet-engine noise.



Three successive optical "spikes" from quasar 3C 345 are shown superimposed. The interval between them is about 320 days. Professor Philip Morrison finds many similarities between quasars—on the galactic scale—and pulsars, which are optically pulsing stars. (Chart: Astrophysical Journal, Vol. 157, p. L74)

Dr. Reethof has worked on the acoustics of fan-jets at General Electric, and he notes that fans are inherently noisy: stator blades steer the incoming air so that it receives the greatest possible impulse from the rotor blades; a proportion of this work of scooping the air towards the engine must appear as sound, of a frequency which is determined by the rate of rotation and the number of blades per set. Attempts at noise reduction so far have brought penalties in weight and performance.

But since fan noise is a single tone, it should in principle be possible to cancel it out with a sound of the same frequency and opposite phase. In his laboratory, Dr. Reethof has a small flame generator which simulates a jet exhaust. The flame is "seeded" with a spray of potassium chloride solution to provide ions which make it electrically conducting. An alternating voltage of around 600 V. is applied between an axial electrode and the nozzle. Connected to the output of a tape-recorder, the flame will reproduce concert music. So frequency and phase are certainly controllable. At present Dr. Reethof is using pure tones from the flame to attempt to cancel out simulated fan-noise generated by a loudspeaker.

The experiment was originally supported by the National Science Foundation and is now funded by the National Aeronautics and Space Administration. It was independently proposed, in jest, by "Daedalus," a pseudonymous innovator who appears weekly in the "Ariadne" page of *New Scientist* (January 11, 1968).

Seek Now a Beginning

Traditional astronomers looked at the universe slowly, with time exposures, assuming that the events they wanted to see were continuing ones. But in doing so they failed to see the crucial quality of two entire classes—or a single class, as is now postulated—of "spinars," sources of immense radio and light energy which reaches Earth in pulses.

"Spinars" is the term given to pulsars and quasars by Philip Morrison, Professor of Physics at M.I.T., speaking to an alumni meeting in Cleveland this fall on a topic on which he first wrote for the *Astrophysical Journal* (August, 1969). He proposed that quasars and pulsars are indeed the same thing, except that one is on the scale of a galaxy and the other on the scale of a star.

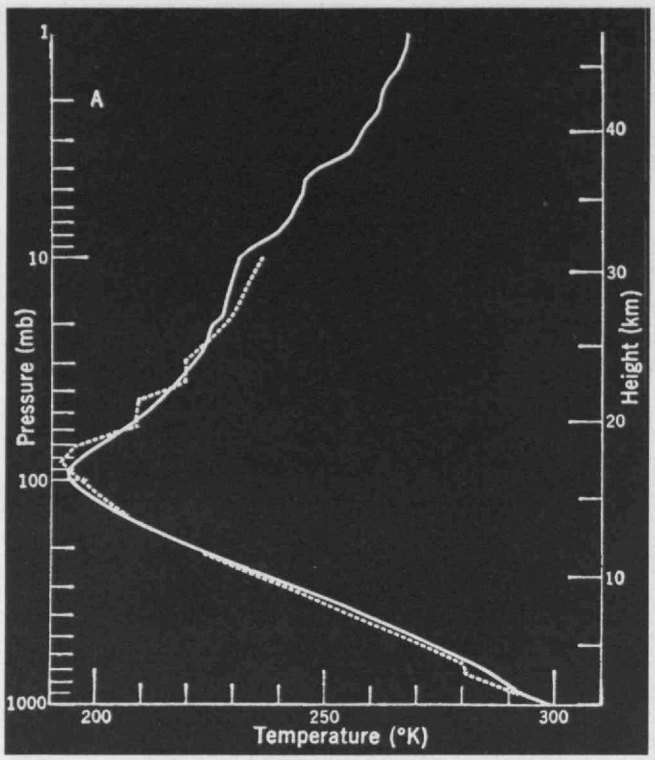
The quasars, the first of which was discovered in 1960, are radio sources of very small angular size, which are also optically visible as stars whose spectrum is shifted a long way toward the red. If, as Professor Morrison proposes, the red-shift is a Doppler shift, and if the distances of the quasars are derived from their apparent velocities as is usual in cosmology, then they are in fact the oldest and most distant objects we can study in the sky.

Quasars also appear to be comparable with galaxies in their energy, which is very large. But in at least one case radiation is discontinuous, coming in bursts with a period of some 320 days. If, as Professor Morrison proposes, such quasars pulse because they are rotating beam sources, then they must be remarkably (for their power and distance) small in size.

Pulsars are already postulated as small, condensed, rotating energy sources—the theoretically predicted "neutron stars" (*see* Technology Review *for January, 1969, page 44*). According to this view, the pulsar is the remains of a star which has exploded; its rotation, and hence the frequency of its pulses, is gradually decreasing.

An example, says Professor Morrison, is the pulsar in the Crab Nebula, a star remnant known to have ex-

The first temperature-sounding of the atmosphere from satellite observations, April 14, 1969. The solid line is the satellite version, and the dotted trace is from balloon sondes. The main source of error was the initial calculation of the infrared transmittance of the atmosphere. (Chart: Science, Vol. 165, p. 1257)



ploded in the year 1054, when it was first observed by Chinese astronomers. The pulsar in the Crab, identified by M.I.T. and other astronomers only within the last year, fully accounts for the energy which is postulated for its parent star, and its pulse rate is in fact decreasing.

Quasars suggest to Professor Morrison the swinging beam of a pulsar but on a far larger, slower scale. He thus proposes that quasars are a late stage in the evolution of the central region of a normal galaxy, just as pulsars are a step in the evolution of a star. Starting about 1,000 light-years across, and containing 10 billion solar masses, the galactic core shrinks, gaining angular velocity and magnetic field intensity. Unlike the case of the collapsing star, the quasar's density does not grow enough to start new nuclear reactions, so it is not this process that eventually slows the rate of shrinkage.

Instead, most of the original mass is thrown off and the remaining core interacts with it magnetically. This magnetic braking becomes the main mechanism for converting rotational kinetic energy into forms in which it can be radiated away.

Professor Morrison's view of the life and death of stars and galaxies is at best only a theory. But it may be a new stage toward resolving the astronomer's dilemma. "If the universe is composed only of what we can see and sense," Professor Morrison told his Cleveland audience, "then it is flying apart so fast that we are the witnesses of a one-time-only performance." But this view is unsettling and in a sense illogical; can our new view of pulsars and quasars show how stars may fall back together again, thus starting a repeat performance?

Usable Data From Weather Satellites

The weather forecasting process consists essentially in obtaining the current temperature, pressure, humidity, and wind at a very large number of points in the atmosphere and subjecting the pattern observed to a combination of physics and human pattern-recognition. The quality of the forecasts, with the best meteorology imaginable, can be no better than that of the original observations. At present, the atmosphere is observed quite well over land areas, but only very thinly over the oceans which constitute most of our planet's area. The remote measurements of air temperature by a Nimbus III satellite last year therefore represent a significant step forward.

Nimbus III, launched in April last year, carries a Michelson-interferometer spectrometer, capable of dividing the carbon dioxide emission waveband (13 to 15 microns wavelength) into seven parts and measuring the radiation intensity in each. Facing directly downwards, the spectrometer receives radiation from the whole depth of the atmosphere over an area 200 km. square and transmits the spectrum to a ground station every eight seconds.

The spectrum is the total of radiation emitted by carbon dioxide at all levels in the atmosphere (depending on local temperatures and pressures) minus the radiation absorbed out on the way up. This relationship can be formulated mathematically, and ways of inverting the resulting equation have very recently been worked out, so that given the spectrum it is possible to arrive at the atmospheric temperatures at a range of pressure levels.

The graph shows the first temperature profile obtained in this way, together with data obtained in a nearby area from radiosonde balloons, for comparison. It is taken from an account by D. Q. Wark and D. T. Hilleary, of the ESSA (Environmental Science Services Administration) National Environmental Satellite Center, Washington (*Science,* Vol. 165, pp. 1256-1258). Another graph, from the same paper, is of interest in that the method proves unaffected by thin, high cirrostratus clouds. Dense cloud, on the other hand, is a real obstacle, and it becomes necessary to interpolate between

the lowest altitude visible and the surface (if indeed the temperature of the latter is known). In a companion paper, R. Hanel and B. Conrath of the Goddard Space Flight Center, Greenbelt, Maryland, describe uses for other parts of the infrared spectrum which were observed at the same time: they include ozone and humidity measurements.

Dr. Frederick Shuman, Director of ESSA's National Meteorological Center, has described the Nimbus III observations as "a breakthrough in observational techniques," and has paid tribute to their "uncanny accuracy," comparable in vertical discrimination to that of radiosondes. However, he said, any attempt to improve the vertical discrimination still further would mean orbiting a disproportionate additional amount of hardware. Also, the temperature measurements will not help very much in dealing with the tropics, where the important unknown is wind.

But one improvement is definitely planned. The present instrument, looking only vertically down, surveys a series of north-south strips, up to 3,000 km. apart. Future versions will be aimed obliquely as well, giving a closer mesh of observations. Also, a reduced field of view will enable the device to take advantage of smaller areas of clear sky.

For Strangeness and Quarks: a Nobel Prize

The 1969 Nobel Prize in Physics was awarded late in October to Murray Gell-Mann, an alumnus of Yale and M.I.T. who is Robert Andrews Millikan Professor at the California Institute of Technology. The citation is for "contributions and discoveries concerning the classification of elementary particles and their interactions."

Three successive major advances in the theory of the "fundamental particles" are the work of Dr. Gell-Mann: the introduction of a new quantum number, known as strangeness; one of the best-known versions of the "symmetry" by which the properties of the particles are pulled together into a comprehensible pattern; and the quark, a proposed new class of particle, currently the center of a considerable stir among physicists on account of reports that it has actually been observed.

All three are theoretical, and each of Dr. Gell-Mann's major contributions was also arrived at independently by someone else at about the same time—strangeness theory by Kazuhiko Nishijima, the "eightfold way" symmetry pattern by Yuval Ne'eman, and the quark by George Zweig. As the story of modern physics unfolds, Dr. Gell-Mann co-authors more of the chapters than others do.

It is an esoteric story, but the plot is based on an older tale—that of the chemical elements. First there were very few particles (proton, neutron, electron, photon); closer examination of matter revealed that there were dozens, and collectively they did not make much sense. Just as the relationships between the elements began to become clear only when a new property was introduced (atomic number), so new properties have had to be assigned to the elementary particles, over and above the classical notions of mass, charge and spin. First, to account for the similarity between protons and neutrons, Heisenberg invented a quantized property confusingly called "isotopic spin." The proton and the neutron are, as it were, "isotopes" of a single particle, the nucleon, identical as to isotopic spin, in the same way that deuterium and ordinary hydrogen are isotopes, identical in atomic number. (The resemblance to spin is purely mathematical; another word would have been better.)

In 1950, a number of new particles were discovered which behaved in such a strange fashion that they simply came to be called "strange." For one thing, they decayed in a radically different manner from the way they were formed, whereas such fundamental processes are generally expected to be reversible. Initially, they were assigned isotopic spins on the basis of their masses.

To Dr. Gell-Mann went the honor of discovering that this was wrong. At that time (1953), he was 24, and he had held his M.I.T. doctorate, obtained under Professor Victor Weisskopf, for all of two years.

He later wrote in *Scientific American* (with a co-author —hence the third-person narrative): ". . . it was a matter of discovery by slip of the tongue. Discussing the heavy strange particles one day, he spoke of them as having an isotopic spin of 1 but then quickly corrected himself, saying, 'I mean one-half, of course.' The more he thought about the 'mistake' later on, the more he began to wonder . . . To be sure, the particles seemed to be related to the nucleon. But if they were members of that family, they were strange members. Perhaps it was precisely in their isotopic spin that their strangeness lay." The difference between the old and new values for isotopic spin became a new quantum number—"strangeness."

This gave a new dimension to the central problem of explaining why some combinations of quantum numbers—in other words, some kinds of particle—were possible, while others were apparently not. Dr. Gell-Mann remained a strong contender in this mathematical steeplechase, and in 1961 he and Ne'eman hit on a

Of Murray Gell-Mann, 1969 Nobelist in physics, Sandra Blakeslee wrote in the New York Times: *"His everyday thoughts attempt to discern and explain the behavior and properties of more than 100 particles—and antiparticles—of matter that are found within the nucleus of the atom." Dr. Gell-Mann was cited "for his contributions and discoveries concerning the classification of elementary particles and their interactions."*

formulation which he called, "the eightfold way" (after a Buddhist phrase roughly corresponding to "the ten commandments," with rightnesses instead of shalt-nots). This, like Mendeleev's periodic table, was a neat pattern, not all of which had been observed in nature. It contained a place for a particle yet to come, which Gell-Mann called the omega-minus. This particle was discovered, amid great rejoicing, in February, 1964, at Brookhaven National Laboratory.

About the same time, Gell-Mann proposed the existence of a particle more fundamental than the rest—the quark. It would differ from anything seen before in having an electric charge which was either one-third or two-thirds that of an electron or proton. This time he took his terminology from James Joyce's *Finnegan's Wake* ("three quarks for Muster Mark"). Last year, in the September 22 issue of *Physical Review Letters,* Dr. Charles B. A. McCusker of the University of Sidney, Australia, reported that, during a program of cosmic-ray studies, his team had observed five particle-tracks which looked as if they had been made by particles with an electronic charge of two-thirds. If these observations are what they appear to be, they are of great importance, and they are accordingly being treated with some degree of caution. For Dr. Gell-Mann they come at an extraordinarily appropriate time.

A System of Systems For Making Systems

The rather systematic description above defines the end result of M.I.T.'s Computer-Aided Design Project, and it comes from the latest annual report of the Electronic Systems Laboratory. The Project began in 1959, funded by the U.S. Air Force, and has just been completed. The project leader, Douglas T. Ross, and his leading staff members have now left M.I.T. to form a private company, Softech.

The idea of computer-aided design is that a computer should take over the more logical, mathematical, and factual chores from an engineering designer, leaving him with the more creative functions. The designer must be able to communicate with the computer in a language which makes no excessive demands on one who is not a computer specialist and which incorporates the jargon of his particular field of design. The designer needs to be able to modify the computer system as the changes occur in the engineering field.

The design of, say, a complete aircraft involves many specialities and thus many different computer aids. The amount of work entailed in creating just one computer-aided design system, for just one kind of computer, is such that the job must itself be computer-aided if it is to be done repeatedly. "The major effort of the project for the past several years has gone into the development of techniques for automating as much as possible of the process of constructing specialized languages and programs, and of the process of moving programs from one computer to another," says the report. For making computer-aided design systems, there is now a "collection of concepts and working tools"—a system of systems—and an understanding of how to use it, the whole going by the name of A.E.D. (Automated Engineering Design).

The system has been adapted for use with I.B.M. 360 computers, completing the Air Force contract; and the termination of U.S.A.F. funding has had the effect of terminating also an effort to put the system on to M.I.T.'s own time-sharing computer system, MULTICS, which is based on a General Electric 645 machine. Softech, the new company which contains the key members of the A.E.D. project, offered to finish the job of giving MULTICS the Automated Engineering Design facility for $70,000. This was a pared-down figure, but a more realistic estimate would still look negligible compared with the amount that the Air-Force-funded project has cost during its ten years—about $5.7 million. To date, the needed extra money has not materialized, apparently because commercial users are already satisfied with the I.B.M. version.

All seven of M.I.T.'s Underwood-Prescott Lecturers in food technology came together for a symposium at the Institute this fall. One, Charles O. Ball of Rutgers University, reported a private survey of current developments among food packaging experts. Only one—from an academic institution—spoke about disposability. But Stanislaw K. Kon, reporting on the growing influence of American methods in the European food market, complained of "a terrifying vista of inert skeletons of food long since eaten" replacing the picturesque European countryside. Packages, he said, "have no right to exist after their job is done."

Food Fundamentals

A return to fundamentals is the key issue in modern food processing. The same message applies to food processors in their search for sales and to government regulators in their search for standards: Don't forget that the fundamental issues in food are good nutrition and sanitation.

When a government regulator is lured into counting the number of cherries in a cherry pie, he is missing the point. So is a food processor who spends his energy devising a more colorful plastic package instead of a way to put better foods in the hands of those who most need them.

Six former recipients of M.I.T.'s Underwood-Prescott Lectureship returned to the Institute late this fall to take part in a symposium and to hear the lecture by the 1969 Awardee, Bernard S. Schweigert, Chairman of the Department of Food Science at Michigan State University.

The European representatives in the seminar agreed, without enthusiasm, that American food processing standards and methods are gradually infiltrating the European market. But they had words of warning: "The fundamentals of nutrition remain rooted in the unchanging basic physiology of man," noted Stanislaw K. Kon, a Past President of the Nutrition Society (England); whatever changes man can make in his foodstuffs are, in comparison, essentially superficial.

The food industries today are losing track of "real human needs," said Henry Cheftel, Director of Research at J. J. Carnaud et Forges de Basse-Indre, Paris; most of today's research is devoted "to convincing the purchaser to buy what he does not need," to devising novelty for novelty's sake. "Only continuing fundamental research into nutritional problems can give us real insight into future human needs," he said.

Dr. Schweigert carried the same theme into the field of regulation in his 1969 lecture, where he supported acts to safeguard public health but deplored efforts of government to affect such "compositional" characteristics of food as the fat content of frankfurters and the cherry content of cherry pies. Dr. Schweigert agreed that consumers may need help in evaluating foods, and government may, where appropriate, require that processors properly label their products. But regulations which primarily affect product composition rather than safety "need careful review to be sure they contribute significantly to consumer interests," he said.

Dr. Schweigert spoke with feeling of the food processors' problems created by overlapping regulation by local, state and federal agencies. For example, he said, although 42 government inspectors recently reported finding no health hazards in cottage cheese, one company processing only a few million pounds of the product annually is subject to inspection by seven different agencies. He called instead for "a more complete and integrated inspection system by a single agency."

Now guaranteed until DECEMBER 31,ST 1976 ~~1975~~

5% BLUE CHIP PLUS 90 DAY NOTICE ACCOUNTS

- **Open your account with as little as $500 and add deposits in any amount at any time up to a maximum of $50,000.**
- **Earns GUARANTEED RATE OF 5% PER ANNUM through December 31, 1976 when funds are deposited.**
- **Interest is compounded DAILY from DAY of Deposit to DAY of Withdrawal.**
- **Free postage-paid bank-by-mail envelopes.**

- **Interest not subject to Massachusetts Income Tax.**
- **Make withdrawals in any amount without prior notice on the tenth day of January, April, July and October, or within the 7 days following one of these dates, if your money has been on deposit for at least 90 days.**
- **Or, you may make withdrawals on any date by giving a 90 day written notice.**

YOUR CHOICE PASSBOOK OR STATEMENT ACCOUNT

Gentlemen: Please open a BLUE CHIP PLUS
☐ Passbook Account ☐ Statement Account
at the following Harvard Trust Office:_____
(please specify office nearest you)

NAME(s) (Please Print)				
ADDRESS	No. and STREET	TOWN	STATE	ZIP
Social Security No.(s)		SIGNATURES		

Mail to: P. O. Box 300, Cambridge, Massachusetts 02139

Enclosed is check for $_____ to open a Blue
($500 minimum)
Chip Plus 90 day notice account which will earn interest at 5% per annum, compounded daily, from date of deposit to date of withdrawal guaranteed until December 31, 1976. I agree to the rules and regulations pertaining to this account.
☐ PLEASE SEND ADDITIONAL INFORMATION

"Your shortest path . . . to person-to-person banking."

HARVARD TRUST COMPANY

Cambridge, Arlington, Belmont, Concord, and Littleton. **Member F.D.I.C. • Federal Reserve System**

Cambridge Journal

"I've Been Fired!"

The dilemma with which its "special laboratories" confront M.I.T. (*see right*) is sharpened by an exaggerated personal issue. Early this fall, President Howard W. Johnson, announcing that the Institute would attempt to change the balance of work in both Instrumentation and Lincoln Laboratories (*see* Technology Review *for October/November, pp. 93B-93C*), revealed that Charles S. Draper would be succeeded on January 1, 1970, as Director of the Instrumentation Laboratory by Charles L. Miller, Head of the M.I.T. Department of Civil Engineering, whose responsibility will be to help implement the "conversion" which President Johnson seeks. Shortly thereafter Dr. Draper was quoted in the press as saying, "I've been fired!"

The question is charged with emotion. The Instrumentation Laboratory has been built and operated in Dr. Draper's image; its success is his success. President Johnson calls him "one of America's greatest engineers," and James R. Killian, Jr., Chairman of the M.I.T. Corporation, has said he is "an authentic genius" of modern technology.

But Dr. Draper is 68—three years beyond the normal retirement age for M.I.T. administrative officers. And he is given to buoyant remarks such as this one (which Victor K. McElheny, Science Editor of the *Boston Globe,* calls his "impish brick"). Dr. Draper was recently quoted in the student paper *Ergo* as saying, "There are only two ways I know of to stop working. One is to quit, and the other is to be fired. I had no intention of quitting."

Nor will he, for Dr. Draper is now Vice-Director for Guidance and Control Programs at Instrumentation Laboratory. Late this fall he and President Johnson issued a joint statement saying "there is basic agreement between us as to the policies of the Laboratory," and Dr. Draper then added, "I am wholly devoted to the future of the Laboratory and of M.I.T."

Defense Research on Campus: The Dimensions of a Dilemma

Ever since World War II, when M.I.T. organized the Radiation Laboratory and John Hopkins University started the Applied Physics Laboratory, to name but two, American universities have played a unique role in performing mission-oriented research in their fields of special competence for the government. There are two examples at M.I.T. today:

Now a $55 million per year operation, the Instrumentation Laboratory developed during World War II within the Department of Aeronautics and Astronautics. Work on gyroscopes originated by its director, Charles S. Draper, led to World War II bombsights and aircraft navigation systems; and later to the principles of inertial guidance which have been applied with remarkable success to missile systems and spacecraft guidance, including the Apollo, Polaris, and Poseidon systems.

Lincoln Laboratory was formed in 1950 at U.S. government urging to develop radar, communications, and computer technology for air defense; its assignments have included other radar and communications developments, re-entry physics, and radar astronomy—as well as basic research.

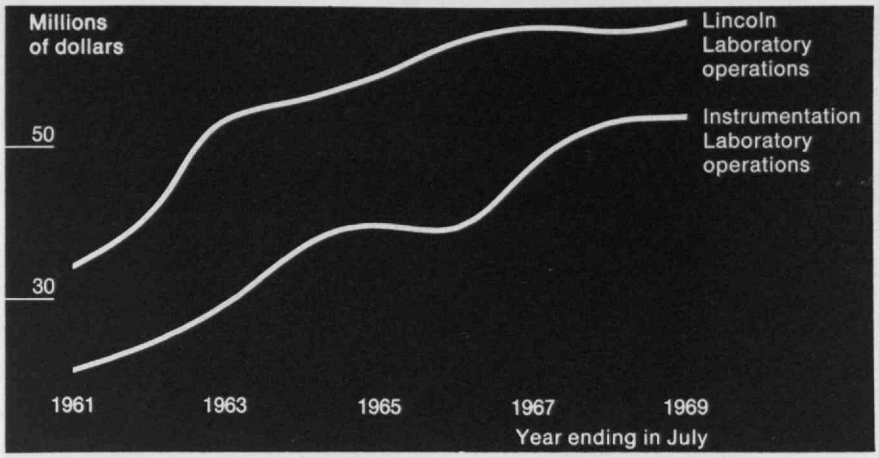
Reappraisal of commitments, such as these of M.I.T. through Lincoln and Instrumentation Laboratories, has been a continuum on every campus involved, and M.I.T. has been no exception. One example was when, in the spring of 1969, a special panel of Corporation, faculty and students said that the Institute should continue to operate its Lincoln and Instrumentation Laboratories for defense research while exploring new means "to provide a more balanced research program" in them.

Later last summer the Corporation affirmed that M.I.T. should remain involved in "advancing the state of technology in areas which have defense applications;" but said that it should "not incur new obligations in the design and development of systems that are intended for deployment as weapons systems." And this fall Howard W. Johnson, President of M.I.T., told the faculty that he will test a plan to increase the laboratories' work in applying technology to social and domestic problems while they continue defense assignments.

The Victims of Success

What kinds of issues now confront M.I.T. in the management of these two enterprises? Though *Technology Review* has previously reported on some of these (*for example, see June, 1969, pp. 72A ff.*), a broader picture of multiple dilemmas is now emerging in a campus-wide dialogue.

1. It is apparent that U.S. priorities are changing. Such problems as environ-



Measured by dollar volume, operations of Lincoln and Instrumentation Laboratories have continued to grow in the 1960's—though, except for additions in the Instrumentation Laboratory occasioned by N.A.S.A.-sponsored guidance development in 1966-68, the Laboratories' total personnel has remained almost constant through the decade.

ment, transportation, waste disposal, and nutrition seem suddenly higher on the agenda of national issues than the further development of sophisticated technology for space adventures or more complex military systems. But these "human" problems are not yet receiving major research commitments.

2. Its talents and its products are so specialized that the Instrumentation Laboratory has made contributions essentially unique in the world. It has agreed to carry many of its projects into test and prototype production—stages in development beyond the normal cut-off point in university laboratories. There has been criticism from within M.I.T. and occasionally from industry—because of the Laboratory's growth and the detailed engineering character of some of its assignments because it was seen as competing with industry.

3. The Instrumentation Laboratory's success has brought it into a political arena (*see right*). Many argue today that the new multiple-warhead technology in which inertial guidance plays a key role changes the conditions of the international arms race so drastically that society in general and the university in particular should reject it. Others argue that the U.S. cannot deliberately and unilaterally renounce any new technology which might yield a military advantage.

4. Both Instrumentation and Lincoln Laboratories have become in many respects integral parts of M.I.T. Both share with the rest of M.I.T. common financial, maintenance, medical, and library facilities, to name a few; and funds representing audited costs to M.I.T. of services rendered—according to Paul V. Cusick, M.I.T. Comptroller, about $7 million annually (not in any sense "gravy," though some have applied that term to it)—are paid by the government to compensate M.I.T.

5. Both Lincoln and Instrumentation Laboratories have had significant benefits for M.I.T. educational programs, for they have—in the words of Jack P. Ruina, M.I.T. Vice-President for Special Laboratories—brought to M.I.T. "the down-to-earth practical skills and expertise necessary to make a great engineering school." Wallace E. Van der Velde, Professor of Aeronautics and Astronautics, has recently written in a position paper to the M.I.T. faculty that "the potential for educational interaction is . . . far greater than that which has already been achieved."

6. "Experience of the last 30 years has shown that U.S. universities have done better defense research less expensively than other organizations," Carl F. J. Overhage, M.I.T. Professor of Engineering who was formerly Director of Lincoln Laboratory, wrote in a position paper to the M.I.T. faculty early this fall. The success of these efforts, he said, depends "on the concurrent pursuit of fundamental research and system development by a single integrated team."

Technology and the Balance of Power: M.I.R.V.

The success of M.I.T.'s Instrumentation Laboratory in developing precise guidance systems for spacecraft and missiles (*see left*) has had a key role in affecting the nature of the international strategic balance in recent years. Thus, the Laboratory and its parent institution have both been brought into the public debate which now surrounds this new technology and its impact on international relations.

Ever since the U.S. and the U.S.S.R. have had intercontinental missile forces capable of destroying the other nation, the weapons themselves were considered effective deterrents despite their enormous destructive potential.

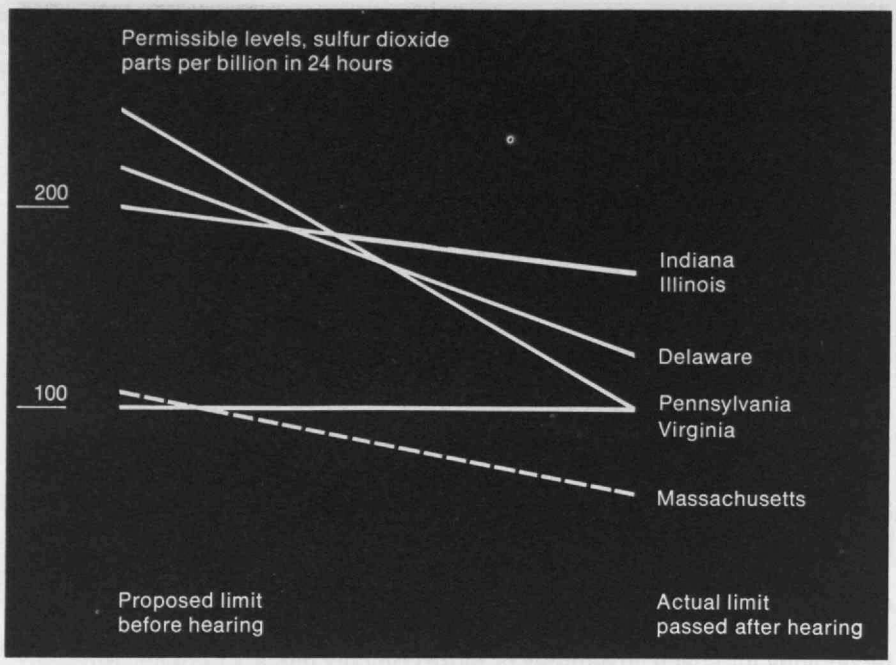
The reason was that each side had approximately 1,000 land-based missiles, each carrying a nuclear warhead at least 50 times as powerful as the bomb dropped on Hiroshima; these missiles, stored underground in heavy concrete silos, could be guided only to within a few miles of their targets. Thus, if either country fired its missiles on a first strike, it could only be sure of direct hits—hence destruction—of a very small portion of the enemy missiles, thus leaving the other side with essentially all of his force for retaliation. Thus, it was in neither's interest to strike first.

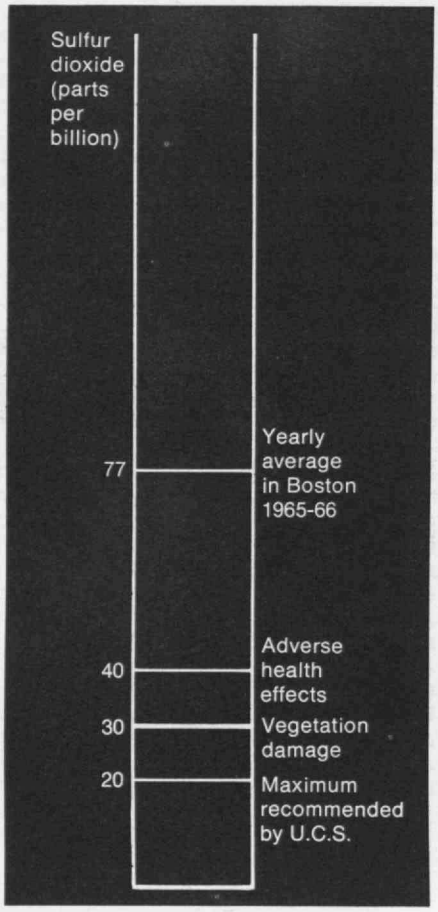
Two developments, however, threaten this stability:

1. The accuracy of missile guidance systems has increased to a point where each side may be able to pinpoint and thereby destroy a much larger portion of the other's land-based arsenal. A first strike thus has greater advantage.

2. The multiple independently-targeted re-entry vehicle (M.I.R.V.) system, now applied to the U.S. Minuteman III (land-based) and Poseidon (sea-based) missiles—and which many fear is being applied to the ever-growing Soviet land-based missile force—enables each to carry several warheads of which each can be independently guided to separate targets with these greatly improved accuracies. Because it may be able to destroy the other side's missiles as well as exhaust any intercept system (such as our proposed anti-ballistic missile system), M.I.R.V. gives the side possessing it enormous first-strike advantages. It thus threatens to upset the previously "stable" situation.

The small charts in the outside columns show that levels of air pollution by sulfur dioxide (left) and particulates (right) in Boston substantially exceed the recommendations of the Union of Concerned Scientists at recent hearings on Massachusetts Air Quality Standards. The bold lines on each chart show the levels proposed for the new standards by the Massachusetts Department of Public Health.





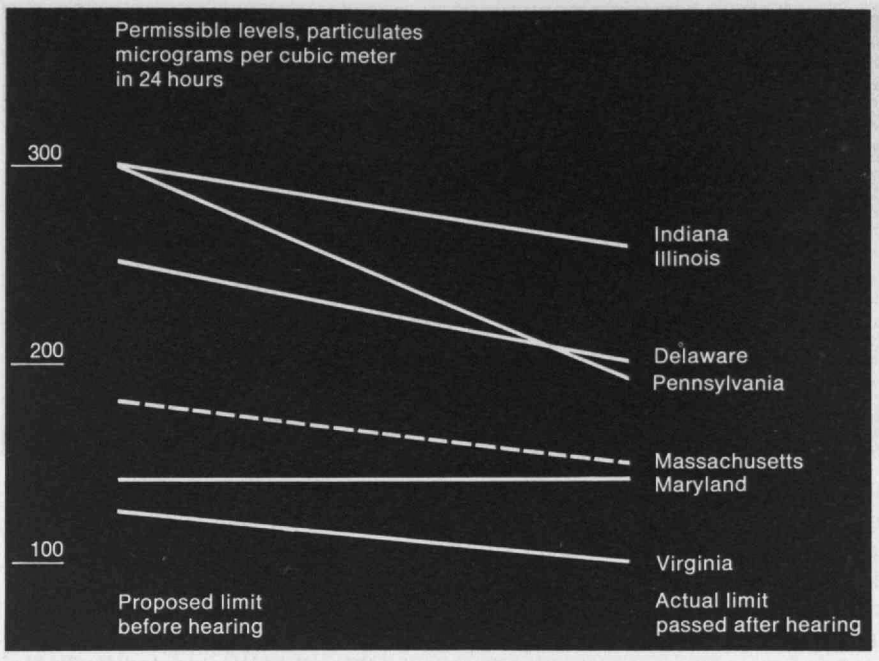
Smog's Four Horsemen

There is no doubt now that air pollution causes serious disease and sometimes death. It has already adversely affected the health of anywhere from 20 to 50 per cent of the population. It costs citizens some $12 billion annually in property damage. Yet even so, the real hazards of pollution—its long-term effects—are hardly known.

These are among the conclusions of a research report published by the M.I.T.-based Union of Concerned Scientists (*see* Technology Review *for May, 1969, pp. 68-71*) to support efforts of the Boston Citizens' Coalition for Cleaner Air (*see below*). U.C.S. translates the consequences of pollution into laymen's dollars-and-cents terms:

◇ *Health.* "There is no longer any doubt that air pollution causes death and chronic disease . . . Among the diseases linked to air pollution are lung cancer, stomach cancer, dyspnea (labored breathing), bronchitis, and other illnesses. . ."
◇ *Cost.* "The national cost of air pollution is currently estimated at about $12 billion annually . . . for damage to property only. . . . (This is) based only on known expenditures." In addition to cities, "smaller towns with various types of mills are also suffering economic loss."

Specific areas were cited:
Pittsburgh. A 1913 study ("the earliest comprehensive study of the cost of air pollution") showed that about 15 per cent of the costs of pollution were actually borne by the polluters themselves.
Ohio River Valley. A 1959 study showed that it then cost $84 more per person per year to live in a region with airborne particulate levels twice the national average. "This is especially interesting because it allows us to estimate a cost-per-microgram-per-cubic-meter of particulate matter," says U.C.S. "This works out to 80 cents per person annually."
Washington, D.C. A study there indicates that costs vary in a substantially linear fashion with the level of particulate emission.
Boston. Given the figure in the Ohio River Valley study applied to Greater Boston, the cost of particulate pollution is $76 million. "An annual cost . . . of between $75 and $100 million is far too much for the privilege of breathing foul and debilitating air," says U.C.S. If the level of particulates in Boston air were reduced by the proposed 50 μg/cu.m., it "would represent a saving to the people of Boston of more than $15 million annually."

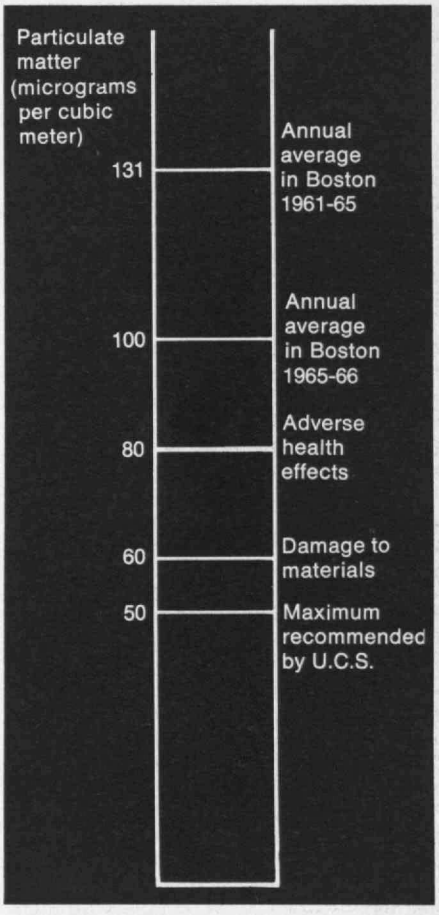


The charts at the top of these pages reveal two facts about government regulation of air pollutants: levels of pollutants permitted under various state standards differ widely, and these levels are determined as much by political as by scientific issues. In each case, proposed levels of sulfur dioxide (left) and particulates (this page) have been pushed downward as a result of public hearings on standards. The broken line shows the average downward trend applied to Massachusetts standards proposed by the state's Department of Public Health. (Data: Union of Concerned Scientists)

◇ *Risk of Air Collisions.* Half of the 24 near-misses over Boston's in-town Logan International Airport last year were due to poor visibility, the F.A.A. has reported. Visibility is especially bad, the U.C.S. report says "just where an aircraft, while landing, puts maximum demands on the pilot's skills."

◇ *Quantity.* In Boston, the U.C.S. report said, "grime comes down at a rate of between 20,000 and 200,000 lbs./sq.mi./mo., depending on the season. Left to itself, this stuff would soon cover the city to a depth . . . greater than most buildings. In fact, most of it gets washed away down the sewers by rain . . . the rest, though, remains for us to clear away."

The U.C.S. report is credited to members of the Union's Committee on Environmental Pollution (Bruce Bailey, Gloria Bloom, Henry Kendall, and James MacKenzie) and of the Harvard Law Conservation Society (Peter Buchsbaum, Joseph Katchen, Scott Lang, and Michael Last).



Boston: Clean Fight Over Dirty Air

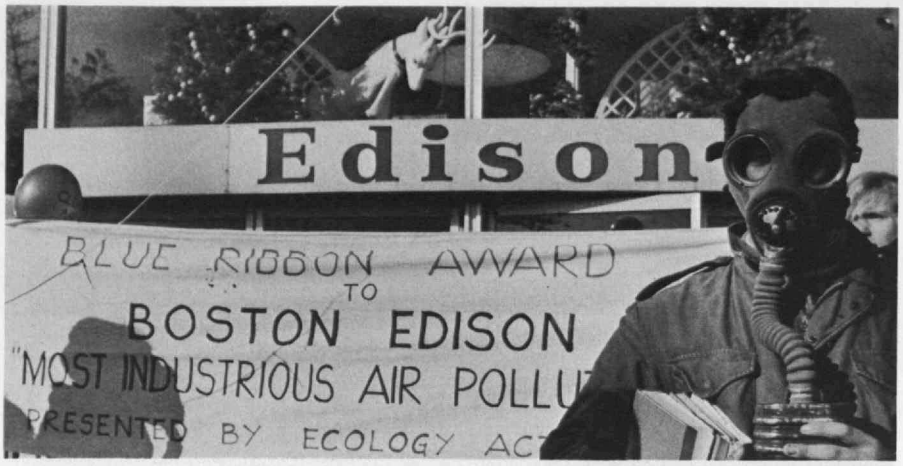
Like motherhood, clean air is something hard to oppose. However, pressed by federal legislation to decide on specific controls for dirty air, many parts of the U.S., including Boston, are uncovering strong differences of opinion.

In general, the private citizen, told that heavy industry pollutes the air and endangers his family's health far more than his burning leaves or automobile, favors strong controls. But industries, especially those with heavy fuel consumption, argue that strong controls are costly and unrealistic.

In Boston this fall the debate escalated into a 12-hour argument when the Department of Public Health held a public hearing on proposed specific limits for two major pollutants. Some 600 citizens appeared at the hearing, arguing that the standards as proposed weren't strong enough. Industry spokesmen presented some opposing views.

It's too early to be sure, but if experiences in other parts of the country are any indication, the citizens' campaign has a good chance of strengthening the proposed standards (*see charts*).

In accordance with the federal Air Quality Control Act of 1967, the Depart-



While Massachusetts held public hearings on pollution control limits which would affect the Boston area this fall, some 50 marchers, enlivened with toy drums, kazoos, balloons and gas masks, marched from the hearings to present the "First Blue Ribbon Polluter Award" to Boston Edison Co. The Company's Executive Vice-President, Francis M. Stazesky, received the award and said that Boston Edison, too, wanted cleaner air. (Photo: Al Bradley, Boston Herald Traveler)

The Citizen Can Act!

A suburban housewife and former nurse who was a member of her town's board of health, an M.I.T. professor who had joined his home-town citizens' group, college students, high school students who were officially taking a class in "government": these made up the 600-odd citizens who turned out to testify on behalf of more stringent public standards at the hearing on Boston area air pollution last fall.

How did they do it? With the help of suggestions from the Metropolitan Boston Citizens' Coalition for Cleaner Air, which distributed suggestions which may well become a standard reference for citizens who want to make themselves heard. Here are some examples:

◇ Anyone who can claim he will be affected by a proposed change is legally able to testify at a public hearing; he need only submit his name and reasons for testifying in advance to the chairman of the board holding the hearing.
◇ In numbers there is strength; if possible enlist your neighbors or fellow workers to testify also; if you can call yourselves a group, you will be better off.
◇ Find out the date, time, place, and formal title of the hearing and give this information to everyone, including the local press (mentioning the topic on which you and your group will testify, and summarizing your point of view).
◇ Find out who has been notified of the hearing in advance; perhaps there are some omissions!
◇ Write out your statement in advance; make many copies, to give to others, to distribute to board members and to give to the press before you read it out at the hearing.
◇ If possible, draw up a sample statement which can be used by those wishing to testify; this will make it easier for them to do so. A useful directive to the citizens speaking out in Boston was, "Be positive. And brief."
◇ Use charts and other visual material to explain your position; they can often help increase understanding in a discussion of technical matters.

ment of Health, Education and Welfare is issuing guidelines for control of certain pollutants, notably sulfur dioxide (*see article, pages 24 to 31*) and particulates (the ash, dust, and carbon particles in the air). The nation is divided into 57 Air Quality Control Regions, of which Boston and the surrounding 97 towns are one. In each region, local environmental health departments must propose specific limits on each pollutant and hold a public hearing before approving that limit and submitting it to Washington for final approval.

Organizing the Boston citizens' campaign (*see pp. 72-73*) was the Metropolitan Boston Coalition for Cleaner Air, a parent organization of medical groups, local town groups, housewives, students, and conservation organizations, formed to press for stricter controls.

Supplying the technical information and laymen's explanation were scientists and engineers from local universities, particularly M.I.T. and the M.I.T.-based Union of Concerned Scientists (*see* Technology Review *for May, 1969, pp. 68-71*), especially James J. MaKenzie, a research associate in physics.

The hearing itself, in the 18th-century Gardiner Auditorium of Massachusetts' gold-domed State House, turned out to be an all-day, late-into-the-night affair. While T.V. cameras and microphones pressed on health officials and other speakers inside, the Cambridge Chapter of Ecology Action presented a "booby prize" for pollution to Boston Edison Co. on the steps outside. Even Massachusetts Governor Francis S. Sargent made a presentation.

After the hearing, U.C.S. submitted a final position paper (*see pp. 72-73*) offering a completely new set of standards for the region, dividing Boston into two areas instead of the usual one, with separate pollution limits for each. U.C.S. as well as the Coalition intends to keep a close watch on further developments, including the public schedule of implementation plans which must follow federal approval.

H.E.W. Blacklist: The Chorover Case

One of the antiquated practices left over from the era of Senator Joseph McCarthy's security investigations is a security check of scientists nominated to serve on non-policy making committees reviewing applications for funds to agencies within the Department of Health, Education and Welfare.

The security checks, with the resulting blacklisting practice, came to national attention last fall when the *New York Times* obtained some of the lists. Subsequently, John G. Veneman, Undersecretary of H.E.W., announced that the blacklists should be discontinued and that a committee within the depart-

ment is studying the practice of security checks and will make recommendations—possibly to end it. Many scientists, including one at M.I.T. who may be a "test case" in possible litigation, are anxiously awaiting the outcome.

The lists are estimated to include some 200 of the 5,000 scientists who serve H.E.W. annually on study groups and review panels. The reasons are apparently personal or political and are judged privately by the H.E.W. Security Department. Their standards bear no relationship to clearances already granted by the Defense or Justice Departments.

Stephan L. Chorover, Professor of Psychology at M.I.T., may have a good case for two reasons. First, unlike many of those on the lists, he can prove he was asked to serve on a committee, the Neuropsychology Research Review Committee, sponsored by the National Institute of Mental Health, in August, 1967; later his formal appointment was denied. Secondly, his professional usefulness to the N.R.R.C. is documented as well. He had also worked for two previous H.E.W. committees on an *ad hoc* basis.

The story runs thus:
Professor Chorover did preparatory work for and attended the first two meetings of the N.R.R.C. in September, 1967, and February, 1968. "During this time," he wrote, "informal conversations with members of the N.I.M.H. staff indicated that my regular appointment to the committee was being sought through appropriate channels.

"However, at the meeting of February 7, I was informed that the application for this appointment was disapproved. Though no explicit information about the reason was available, I was told that the adverse action was not based on any shortcomings in my performance as an *ad hoc* member of the review committee. . . . I was left with the clear impression that political considerations played a prominent (if not exclusive) role in this decision."

N.R.R.C. appealed to Dr. Stanley F. Yolles, Director of N.I.M.H., who replied later that the recommendation was again denied and that further channels for appeal were "exhausted." A second attempt to secure reversal of the disqualification also failed.

In March, 1969, Professor Chorover was told that, as a last recourse, he could authorize a "full field investigation" by the F.B.I. of himself and his activities. By implication, if the F.B.I. cleared him, he could have better grounds for appeal with H.E.W.; however, F.B.I. clearance could not in any way guarantee H.E.W. clearance.

He decided not to do it. "It would be dishonest and irresponsible for me to 'authorize' such an investigation. To do so would not only falsely imply my endorsement of the practices which have been used against me, but would also entail my willing connivance in the execution of a policy that I regard as morally reprehensible and contrary to the national interest."

The N.R.R.C. has actively protested Dr. Chorover's case; there is also a group pressing to end the whole clearance procedure headed by Dane G. Prugh, M.D., President of the American Orthopsychiatric Association and chairman of the Ad Hoc Task Force on H.E.W. Security Clearances. By now national press and the American Civil Liberties Union are interested in the matter; A.C.L.U. is now in correspondence with Professor Chorover.

Dr. Prugh argues, "These rejections are made on the basis of security and suitability without affording the candidates opportunity to confront the "record" asserted against them . . . such rejections may be based upon irrelevant or archaic considerations . . . the entire process of conducting security investigations for non-sensitive persons is an unwarranted practice. Its continuation results in injury both to fully qualified scientists who without benefit of due process, are found disloyal and unsuitable, . . . and to the Government, which is arbitrarily deprived of their talents."

The Case of Professor Luria

In the October 20 issue of the *New York Times,* reporter Richard D. Lyons, who had obtained his second alleged "blacklist" of scientists barred from H.E.W. study sections (*see left*) because of personal or political affiliations, wrote that the new list included Salvador E. Luria, Sedgwick Professor of Biology at M.I.T., whose Nobel Prize in Medicine had been announced only days before.

Professor Luria has steadily declined to comment directly on his own case, because, as he says, "I don't have any hard facts, only the newspaper reports." However, Mr. Lyons also wrote that it is customary for those on the lists to be unaware of being listed, since there exists no formal application or public review process in the course of the H.E.W. security checks.

However, Professor Luria has commented on his view of the practice in general, which he says is "preposterous. Only the government loses," he says. In a formal statement released after the *Times* story appeared, he said, "I trust that the unwise use of tests of political conformity by the National Institutes of Health and other agencies will promptly be discontinued."

However, Dr. Luria also let it be known publicly, several years ago, when he learned of the H.E.W. tests, that he would not be interested in being on any of the panels or committees "so long as they had the tests they are reported to have." Ironically, however, Dr. Luria has had good relations with H.E.W. over the years and has received research grants from them since 1954-55. In fact, when his Nobel Prize was announced, H.E.W. Secretary Robert Finch sent Professor Luria a telegram of congratulations.

Puzzle Corner
Allan J. Gottlieb

That Census Taker Is Back Again

This being the third column of the year, solutions will begin to appear next month. We allow three months between the presentation of a problem and the printing of its solution so that everyone has sufficient time to work on it. Since I must submit my column one month in advance, you have effectively two months. The reason for this long-winded explanation is that several people have asked why their solutions failed to appear when they expected them to. (I should also like to repeat a plea that everyone refer to problems by *number*.)

Problems

Let's begin with the following from Dr. John E. Prussing:

11 A living group calculated its collective grade point average for the all-campus competition. The average grade point was determined to be 3 1/3. The members of the group were also competing for the *Voo Doo* Highest Average Reciprocal Grade Point Award. This grade point is formed by averaging the reciprocals of the individual grade points.

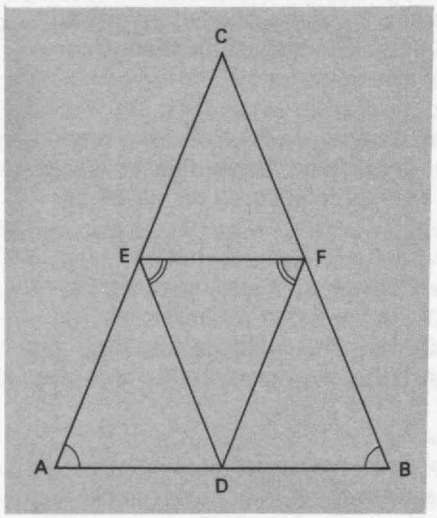
This living group was the last to enter the competition, and the highest average reciprocal grade point prior to their entry was 0.29. The group had to rush to enter before the competition deadline and had time only to calculate their average grade point of 3 1/3. However, the judge looked at this number and declared the group to be the winner of the *Voo Doo* Award. How did he know?

12 Stellar first baseman John P. Rudy, '67, submits the following bridge problem:

	♠ A K 9 4 2 ♥ A 3 ♦ A 6 5 ♣ A 7 3	
♠ 6 3 ♥ Q J 10 9 8 7 6 5 4 ♦ K ♣ 2		♠ 10 ♥ — ♦ Q J 10 9 8 4 ♣ Q J 10 9 6 5
	♠ Q J 8 7 5 ♥ K 2 ♦ 7 3 2 ♣ K 8 4	

Bidding: West: 4♥; North: double; East: pass; South: 4♠. Lead is Q♥. Dummy's ace is put up and ruffed by East. Make any return.

13 Arthur A. Hauser, Jr., has found a new problem similar to number 24 of last year. He wants you to find conditions on the ratio of the altitude to the base of isosceles triangle ABC such that the inscribed triangle DEF with maximum area (D is at the midpoint of AB) has FE parallel to AB.



14 Paul D. Berger, wants you to find a function f defined on the entire real line such that

1. f is bounded and strictly increasing;
2. f is continuous at each point x; and
3. $\lim_{x\to-\infty} f'(x) \neq 0 \neq \lim_{x\to\infty} f'(x)$

15 First recall problem 30 from last year:

"A mathematician moonlighting as a census-taker stops at his friend's house. In this census he is required to obtain the names and ages of all the occupants of the house. After writing down several names and ages the census-taker asks, 'Are there any more people who live here?' His friend replies, 'Yes, there are three more people that live here.' When asked for their ages, the friend reports that the product of the ages is 1296 and the sum is the street number of his house. The census taker makes a few calculations and then says, 'Just tell me one more thing: How many of the three are older than you are?' As soon as his friend replies, the census taker smiles, writes down the ages and leaves. What is the house number?"

Captain John Woolston proposes a variation where two veterans (i.e., older than 18) discuss a similar situation where the house number is not known. One veteran asks how many of them are older. Which reply allows him to determine the house number?

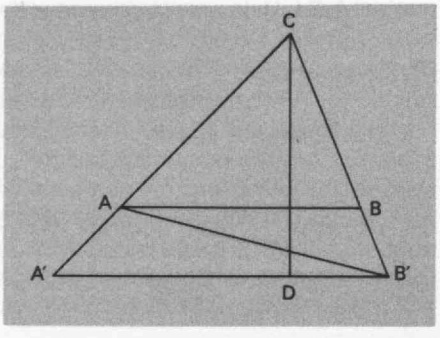
Speed Department

SD5 T. Terwillager wants you to decide to which problem in last April's Puzzle Review this is the answer:
B2C3MR11
C3M11BCR
BC3MR11C
3M11B2CR
B3MR112C
MR11B2C2M
BC2MR11CM
CM11BC2MR
B2C2M11MR
2C11B3MR
B2CR113M
C11BC3MR
BCR11C3M
11B2C3MR

SD6 Prove that if 0 = 1 then Nixon is the Pope. By the way, Bertrand Russell had no trouble with a similar problem.

Better Late Than Never

33 Form ΔABC from the given three altitudes, where AB is the shortest and AC the longest.



Someone finally solved this one. Smith D. Turner submitted the following:

Draw the altitude from C, extending to make DC = AC. Through D draw a line parallel to AB to meet CA and CB extended at A' and B'. CA'B' is the required triangle.

34 Both Mr. Turner and Donald E. Savage noted that Mr. Osgood's proof (Technology Review *for October/November, page 87*) is incorrect. Mr. Savage comments that the solution as published "is a good illustration of an 'extraneous root.' Had he plugged his numbers ($R = 1.22$, $r = .83$) into the second equation, he would have found $7.6 = 2.4 + 10$. While I agree that his quartic follows from the original equations, it has four roots, three of them extraneous to this problem. The correct root is $R = 2.1$, so that $r = 1.9$ (to two places)."

Allan J. Gottlieb is a Teaching Assistant in the Department of Mathematics at Brandeis University (Waltham, Mass. 02154), where mail about Puzzle Corner should be addressed.

David L. Holt
Tech Crostic

Of Pipe-Fitting and Sulfur Acids

■	■	■	■	J 1	Q 2	D 3	N 4	P 5	K 6	A 7	U 8	G 9	■	B 10	K 11	R 12	S 13	C 14	L 15	M 16	E 17	■	V 18
G 19	W 20	E 21	■	I 22	L 23	S 24	Q 25	F 26	W 27	B 28	■	R 29	D 30	T 31	I 32	E 33	V 34	■	X 35	J 36	O 37	■								
K 38	D 39	P 40	Z 41	U 42	Q 43	C 44	■	E 45	J 46	Q 47	Z1 48	I 49	M 50	U 51	■	K 52	P 53	A 54	Z 55	■	Q 56	F 57								
■	M 58	O 59	Z1 60	A 61	W 62	U 63	F 64	S 65	C 66	K 67	B 68	■	E 69	P 70	X 71	C 72	■	Y 73	K 74	R 75	■	Z1 76								
H 77	C 78	B 79	G 80	P 81	U 82	Z 83	A 84	W 85	■	T 86	H 87	J 88	Z1 89	S 90	D 91	N 92	Q 93	K 94	W 95	■	P 96	H 97								
U 98	M 99	I 100	R 101	C 102	K 103	■	V 104	M 105	X 106	T 107	K 108	N 109	S 110	E 111	W 112	■	U 113	A 114	D 115	Y 116	W 117	I 118								
E 119	C 120	Z1 121	■	P 122	F 123	J 124	Z 125	Y 126	I 127	■	B 128	R 129	C 130	■	C 131	Y 132	■	S 133	■	F 134	P 135	L 136								
I 137	H 138	Z 139	K 140	R 141	■	S 142	B 143	■	N 144	K 145	G 146	■	P 147	Z 148	K 149	H 150	X 151	■	C 152	S 153	V 154	Z1 155								
D 156	K 157	■	I 158	Y 159	M 160	L 161	■	O 162	F 163	■	E 164	N 165	V 166	■	C 167	J 168	■	U 169	■	I 170	F 171	U 172								
P 173	K 174	Z1 175	V 176	G 177	■	V 178	T 179	■	I 180	■	E 181	G 182	L 183	B 184	V 185	U 186	■	H 187	Z 188	K 189	T 190	S 191								
■	Z1 192	I 193	■	W 194	Y 195	I 196	K 197	■	A 198	V 199	H200	Z 201	J 202	M203	S 204	C 205	N206	—	L 207	H 208	Z 209	G 210								
—	Y 211	O 212	C 213	V 214	D 215	L 216	U 217	Z1 218	E 219	I 220	■	B 221	Z 222	P 223	C 224	M 225	T 226	X 227	A 228	S 229	E 230	■								

Use the definitions at the right to help define the words to which they refer; then enter the appropriate letters in the diagram to complete a quotation from a work on computers. The first letters of the defined words give the author and title from which the quotation is taken. Black squares in the diagram indicate the ends of words; when there is no black square at the right end of the diagram, the word continues on the next line.

The correct solution to this Tech-Crostic will appear in the February issue of *Technology Review*.

David L. Holt is Assistant Professor of Metallurgy at M.I.T. He will welcome readers' comments; address him in care of *Technology Review*, Room E19-430, M.I.T., Cambridge, Mass., 02139.

A. Wrench.
— — — — — — —
54 114 198 84 61 228 7

B. Pipe fitting with several lateral outlets, for connecting one pipe with others.
— — — — — — — —
128 221 10 79 143 184 28 68

C. Last words of word I, 4 words followed by word K.
— — — — — — — — —
205 224 44 131 78 120 213 66 130
— — — — — —
167 72 14 102 152

D. System of aerial navigation using television and radar.
— — — — — — —
91 39 3 115 215 156 30

E. Relatively stable state of equilibrium in an organism, or tendency toward such a state.
— — — — — — — — —
21 45 164 219 119 181 33 111 230
— —
69 17

F. French mathematician.
— — — — — — —
134 64 171 163 123 57 26

G. Animate.
— — — — — — —
182 210 9 19 80 146 177

H. Overlapping each other.
— — — — — — — —
97 77 150 187 138 208 87 200

I. German scholar, theologian and physician who becomes a magician and conjurer (latinized spelling; 2 words).

220	158	137	196	100	127	170	180	32
	22	118	49	193				

J. Pitch, asphalt; tar, petroleum, naphtha.

1	88	124	46	202	168	36	

K. See word C (2 words).

94	145	52	11	149	74	108	38	174
	140	189	197	67	157	6	103	

L. A refrigerant.

183	15	161	216	207	23	136

M. Unit of electrical power.

16	225	160	105	99	203	50	58

N. Chain; connected series.

206	4	144	92	109	165

O. Repute; smell

162	37	212	59

P. Oral; not written.

96	135	70	173	53	223	81	5	147
	40	122						

Q. A white solid, one of the rare earths.

47	25	93	56	2	43

R. Keep; hold; employ.

101	75	12	129	29	141

S. Canadian natural feature (2 words).

142	204	191	133	13	90	229	153	24
	110	65						

T. Sail nearer the wind (2 words).

107	86	179	226	190	31

U. Succeed or fail (3 words).

51	98	169	172	186	113	42	63	8
	82	217						

V. City in Ohio.

166	176	199	104	154	34	214	178	18
	185							

W. Strong, stout; resolute.

62	85	117	95	194	27	112	20

X. Contaminate.

151	35	227	106	71

Y. Pertaining to the alimentary canal; intestinal.

126	159	73	132	116	195	211

Z. A sulfur-containing amino acid.

222	83	55	125	139	201	188	209	148
	41							

Z_1. Glider with a wind load small enough to enable it to rise in an upward air current.

121	60	175	89	48	218	192	155	76

SCHOOL TIES

The M.I.T. shield is woven in a repeated pattern on plain backgrounds of red, black or navy. Fine quality silk repp, $5.

PERSONALIZED PLAQUES

Cast bronze M.I.T. emblem is mounted on solid hand-rubbed walnut, shaped as a shield or rectangle (both 8½" × 11"). Graduate's name is engraved on the brushed sheet bronze nameplate. Engraving is filled with black inlay so letters appear in distinctive double outline style. Choose from four engraving styles. Excellent gift idea. Order from Tech Coop. $18.95.

M.I.T. CHAIR

Famed for quality craftsmanship, selected northern hardwoods, gold M.I.T. shield, gold decoration on handsome black finish, the M.I.T. chair has earned the right to be a tradition. Choose black arms, $41, or cherry arms, $42. Red and grey Duraleather covered cushion, $11.

M.I.T.

Nice to have around.

DIRECTOR'S CHAIR

Features the 3-color M.I.T. crest on the heavy white duck and black or natural varnish finish on the sturdy, foldable frame, $17.95. For more information, write for chair brochure.

THE COOP

M.I.T. STUDENT CENTER
84 Massachusetts Ave.,
Cambridge, Mass. 02139

Gentlemen:
Please send information on
the insignia items checked below.

Chairs	Tankards
Ties	Sweatshirts
Rings	Slumber shirts
Plaques	Jewelry
Glassware	Office accessories

name _____

address _____

_____ zip _____

coop # _____

SCHOOL RINGS

Graduate students and alumni may order the authentic M.I.T. ring with the well-known "Brass Rat". Three letters engraved free. Prices start at $37.50. Ladies styles also available.

Insignia gifts
The Tech crest on party glassware, tankards, sweatshirts, slumber shirts, jewelry and office accessories make these cherished reminders of M.I.T.

Institute Review

M.I.T. as Cambridge Citizen: Arrogance, or Beneficence?

Ever since its founding, M.I.T. has had close emotional ties to industrial enterprise. William Barton Rogers wrote in his plan for the Institute he hoped to found in Boston, ". . . We may safely affirm that there is no branch of practical industry, whether in the arts of construction, manufactures or agriculture, which is not capable of being better practiced, and even of being improved in its processes, through the knowledge of its connections with physical truth and laws. . . ." When M.I.T. was first located in the Back Bay, and later when it moved to Cambridge, close proximity to industry was a criterion in its choice of sites.

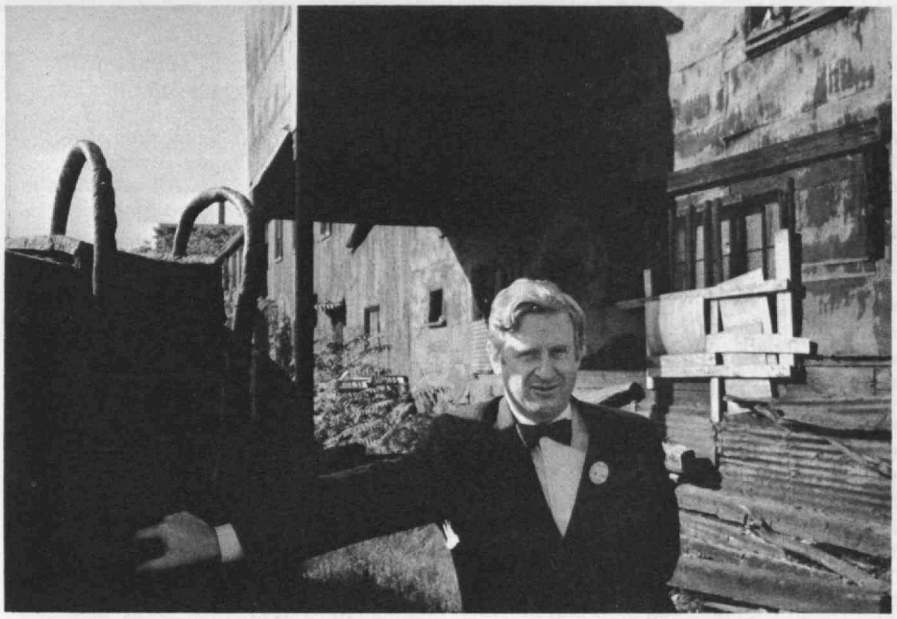
But technology has changed, and M.I.T. with it. Is the environment which has seemed so important for over 50 years still appropriate to the Institute? Indeed, what is the proper role for any educational institution in deliberately supporting or changing the nature of its urban environment?

When these questions engaged the M.I.T. Corporation's Advisory Committee on Institute-Wide Affairs late this fall, M.I.T.'s response was made clear: it would be "terribly arrogant" of the Institute "to try to make Cambridge something different than it is," Howard W. Johnson, President of M.I.T., told the Committee. Simply bringing 8,000 students to Cambridge for classes "has a large effect on the city," he admitted. "But I think it has been the view of most people at the Institute," he said, "that Cambridge is an exciting and effective educational backdrop for our kind of education."

Yet President Johnson at the same time admitted to a dilemma: "The gradual deterioration of industry, the number of abandoned places of work around us are visible to everyone," he said, and so "we have to be concerned about jobs in this area, and we must help make possible a better economic climate in this city."

Four Points of M.I.T. Action

Hence M.I.T.'s policy to support the city of Cambridge through a number of activities and programs listed for the Committee at fact-finding sessions this fall:



Antony Herrey, S.M.'57, Institute Real Estate Officer, is photographed in the midst of what he describes as one of "the sins of our fathers now being visited upon us. Everywhere we go in Cambridge," says Mr. Herrey, "we encounter completely archaic industrial operations—or dilapidated, underdeveloped sites remaining after such enterprises have moved to better locations." It is such sites that M.I.T. has been assembling for a housing program to reduce a severe shortage in Cambridge—part of a large issue of community relations examined late this fall by the M.I.T. Corporation's Advisory Committee on Institute-Wide Affairs. (Photo: Rick Stafford from the Harvard Bulletin)

1. Student housing. The growth of its universities, the attraction which they constitute, and the post-war "baby boom" have combined with a decline in new construction to give Cambridge a serious housing shortage, said Walter L. Milne, Assistant to the Chairman of the M.I.T. Corporation.

At the same time the Institute has made plans to enhance its educational program by providing additional on-campus student residence. By 1975 there will be 2,300 undergraduates in M.I.T. houses and 1,200 in fraternities, and on-campus housing will accommodate 800 single and 400 married graduate students. The steps to this goal include building two new undergraduate houses and one new apartment building, remodelling Burton House, and somehow bolstering the M.I.T. fraternity system. One of the undergraduate houses, McGregor House, is now under construction, and the new building with student apartments, Westgate II, is in the final design process.

2. Real estate management. Through the Northgate Community Corporation, a not-for-profit corporation devoted to building and operating rental properties, M.I.T. has sought to add to the housing stock and to stabilize the Cambridge real estate market. The problem, said Frederic W. Watriss, '41, Assistant Treasurer, was clear in 1965: the competition for housing led to rent increases and then tax increases and then further rent increases—the whole complicated by rapid turnover of absentee ownership "To stop the spiral," Mr. Watriss said, "required a stable owner who could be satisfied with a low return on his property," and the Northgate Corporation was devised to play this role—and, in the process, to

Cambridge property owned by M.I.T. as of December 1 is shown in black on the map. Most of it is used for teaching and research activities; some, on which full Cambridge property taxes are paid, is held for investment and used by commercial tenants. The property of the Simplex Wire and Cable Co., which is under purchase agreement by M.I.T. when vacated by the company later this year, is shown in gray. In addition, M.I.T. temporarily holds title to a few sites elsewhere in Cambridge (see Technology Review *for May, 1969, p. 76) which are to be developed for public housing.*

make it possible for some graduate students and junior staff of M.I.T. to find accommodations at rents which they could afford.

Now, Mr. Watriss told the Committee, the Corporation owns 300 housing units in Cambridge; of these, 144 are rented to M.I.T. families, 32 are available for low-income housing under agreement with the Cambridge Housing Authority, and 109 are occupied by non-M.I.T. Cambridge families. The Corporation pays full property taxes on all its holdings, Mr. Watriss said. Pressed by questions about recent M.I.T. policies in connection with the management of these properties, Antony Herrey, S.M.'57, Institute Real Estate Officer, observed that "a landlord's role is not easy. Someone has to collect the rents, someone has to make the judgments," he said.

3. Housing catalysis. Despite a good deal of discussion leading to several organized programs, the City of Cambridge, like many other cities, has been frustrated in its efforts to meet housing needs in the past 15 years. One stumbling block has been space, for Cambridge land is sub-divided into many small parcels most of which are fully occupied—if by obsolete structures—and assembling land units suitable for development is difficult.

Thus more than a year ago M.I.T. conceived the role for itself of catalyst for housing development in Cambridge, proposing that an independent institution with its own substantial leverage and resources to invest might in fact operate more effectively than a group of public agencies with political problems superimposed on financial ones. In April, 1969, M.I.T. announced that the Institute had assembled five parcels of land in five different parts of Cambridge with a potential for construction of 1600 new dwelling units, of which some 800 might be subsidized as low-income housing (*see* Technology Review *for May, 1969, pp. 75-76*).

Since then, Mr. Herrey told the Corporation Advisory Committee, "prodigious effort and thought" have been devoted to resolving how these five parcels might best be used. There have been coffee hours in every neighborhood, large open houses on some of the sites at which development alternatives and schedules have been displayed for discussion, and other efforts to involve area residents.

The first concrete issue to come before the city in connection with this program is zoning. Restrictions on many of the sites must be changed if the projects which have apparently won approval in the neighborhoods are to be possible. Two months ago, said Mr. Herrey, these issues were brought before the Cambridge Planning Board where, he reported, the "overwhelming response was positive." The zoning changes have just been approved by the Cambridge City Council, Mr. Herrey said, and "we are now quite confident that the city, with very strong citizen support, will back this whole program."

Though Mr. Herrey called the zoning issue "the most complicated, the most controversial, and the most difficult," he emphasized that it is not the only roadblock to progress for M.I.T.'s plans. The Institute hopes to use the "turnkey" system for developing the low-income units on these properties, and recent action by the Suffolk Superior Court ruling this system not in violation of state laws on competitive bidding and wage rates is an important development. But after all this remains the question of funding.

4. The Simplex property. All the issues confronting M.I.T. in its relationships with the city of Cambridge now rise again through the Institute's agreement to purchase property of the Simplex Wire and Cable Co. near the campus when that company moves to a new out-of-state plant late this year. The property consists of 18.7 acres in 11 separate parcels (the largest of which is seven acres), upon which are employed 635 workers.

O. Robert Simha, M.C.P.'57, M.I.T. Planning Officer, told the Corporation Committee that the property is now being evaluated in planning terms. Preliminary results indicate, he said, "that a major portion of this property holds a great opportunity to generate new employment and taxes for Cambridge through industrial use." Residential use is more difficult, because the property is "buried within a 135-acre industrial area," said Mr. Simha, but "we think there are some interesting opportunities."

M.I.T.'s final decisions will reflect the special need of Cambridge, said Mr. Simha, for new employment opportunities; he hopes the Simplex property can be developed to attract "labor-intensive" industry.

"Surrounding M.I.T. with Life"

But M.I.T.'s real need, said Steve Weinberg, a member of the audience, is for attractive residential areas near the campus for both students and faculty. Why not use the opportunity presented by the Simplex property to move Cambridge in the direction of becoming simply a real intellectual, scientific center? Make that property into a "Tech Village," an arrangement which "surrounds M.I.T. with life—theaters, shops, schools," he said.

A much larger question came from Jay W. Forrester, S.M.'45, Professor of Management who is a member of the

Corporation Advisory Committee, whose systems analysis of urban problems is attracting national attention (*see "A Deeper Knowledge of Social Systems" in* Technology Review *for April, 1969, pp. 21 ff.).* Professor Forrester said he was "troubled by the very great difficulty of deciding what is M.I.T.'s self-interest and what is Cambridge's self-interest."

He pointed out what his computer studies have already demonstrated: "The pressures under which we operate," he said, "sometimes lead us to take actions which in the short run appear sound but in the long run are very destructive of our city or the city's self-interest." For example, he asked, is it consistent to maintain a concern for low-income housing in Cambridge if jobs are in fact disappearing? Or are we simply bringing into the city people for whom there will be no work? Professor Forrester warned that "tremendous forces may be at work which will defeat whatever effort we make to maintain the character of Cambridge. The self-evident, obvious humanitarian moves may in fact not be in either M.I.T.'s or the city's self-interest," he said.

Dr. James R. Killian, Jr., '26, Chairman of the Corporation, agreed that "these kinds of fundamental policy questions are very relevant, timely, and important. M.I.T. has sought," he said, "to understand the needs of the city and to respond to them in benign ways"—without claiming prescient or paternalistic role.

$1 Million Grant for Communications and Biomedical Engineering

A grant of $1,000,000 to M.I.T. from the Alfred P. Sloan Foundation, announced this fall by Nils Y. Wessel, President of the Foundation, and Jerome B. Wiesner, Provost of M.I.T., will be used for research and teaching in communications and biomedical engineering and for related physical facilities for the Department of Electrical Engineering and the Research Laboratory of Electronics, an interdepartmental organization bringing together engineering and science faculty and students around the focus of electronics.

"M.I.T. has pioneered in the area of communication sciences," Dr. Wiesner said in paying tribute to the Sloan Foundation for its grant. "We are now entering a new phase in which such work is more closely identified with medical research," he said, "and we believe that research and teaching in the area holds great promise."

The program for R.L.E., toward which the Sloan grant will be applied, includes a new building of 150,000 square feet for the Department of Electrical Engineering and the Research Laboratory of Electronics. The new gift brings to nearly $12,000,000 the amount raised toward the goal of at least $15,000,000 for this new construction. The new facility will replace in part a "temporary" wooden building constructed during World War II for the Radiation Laboratory; it will connect with the Karl Taylor Compton Laboratories, which now houses a substantial part of R.L.E., and to the building completed in 1968 which houses the Information Processing Center—the principal center for computing services at M.I.T.

"People come to a science museum," said Bradford Washburn, Director of the Boston Museum of Science, "for fun, to explore the world in which we live—for a smorgasbord." More than 300 members of the M.I.T. Club of Boston and their guests found he was right at "M.I.T. Night" at the Museum in October.

"Fascination and Wonder"

"The fascination, intricacy, and wonder of science," in the words of Bradford Washburn, Director of the Boston Museum of Science, were displayed to more than 300 members of the M.I.T. Club of Boston and their families on October 23, when the Museum opened its doors to the inaugural meeting of the Club's 1969-70 season.

Following a buffet supper in the Museum's Skyline Room, visitors browsed through three floors of exhibits and witnessed the presentation on "U.F.O.'s Today" arranged by Lawrence M. Schindler, '61, in the Museum planetarium. D. Reid Weedon, Jr., '41, President of the Museum, welcomed the visitors.

Arrangements for the evening were made by John J. Batter, Jr., '53, President of the M.I.T. Club of Boston, Marvin C. Grossman, '51, and Thomas H. O'Connor, Jr., '60, Secretary-Treasurer of the Club.

The Great 1970 Non-Polluting Transcontinental Car Race

Two faculty members from M.I.T. and the California Institute of Technology have announced plans for a coast-to-coast collegiate Clean Air Car Race in which low-pollution vehicles—electric, steam, turbine, hybrids, and others—will compete over public roads from Massachusetts to California next September.

The contest is an outgrowth of the Great Electric Car Race in which two student-designed vehicles from M.I.T. and Caltech competed in the fall of 1968 (*see* Technology Review for *October/November, 1968, pp. 83 ff.),* but the 1970 race will be bigger and open to more kinds of entries. The vehicles may be designed, developed, built, and paid for by any kind of organization, including commercial companies and foreign groups. The restriction is that only groups of college or university students may do the actual driving.

The organizers are Richard D. Thornton, Professor of Electrical Engineering at M.I.T., and Jerome Shapiro, Professor of Engineering at Caltech. Preliminary rules are available from either of the organizers and from their institutions' public relations offices. All prospective entrants are asked to make themselves known to either sponsor by February 28.

The competition will be divided into three parts. The first part will consist of a series of short events which emphasize performance, safety, road handling, and energy consumption and will start September 2. The second part will be a race from M.I.T. to Caltech starting September 9, and the final part will consist of emission measurements to be made in California at the conclusion of the cross-country race. Points will be awarded for each part of the competition, and prizes will be awarded for winners of each part as well as for the overall winner. All entrants must participate in all three parts of the contest.

The transcontinental race will be divided into six legs between Cambridge, Cleveland, Chicago, St. Louis, Oklahoma City, Albuquerque, and Pasadena. Recharging stations for electric entries will be arranged by the race organizers in advance. Each leg will be started at a prescribed time on successive days. For each leg, each entrant will be allowed up to 10 "time-outs," none of less than 30

minutes or more than one hour, for activities such as charging, refueling, and making repairs. All vehicles will be subject to existing traffic laws.

The scoring will penalize any vehicle which produces pollution in excess of the 1974 California standards during designated portions of the trip in which pollution measurements will be made.

Toward Fundamentals: Food, Cities, Computers, etc.

Four examples of how M.I.T. is seeking to be "a basic force in solving the problems of the world," the task which Howard W. Johnson, President, described as "absolutely fundamental," were brought to over 300 alumni and their guests at a Regional Conference at the Statler-Hilton, Cleveland, on October 18:

We still think of the universe as we see its visible light—with our eyes and through telescopes. But we are now seeing "a new cosmos," said Philip Morrison, Professor of Physics, "by opening shutters across windows in our universe we are only beginning to discover." The result, he said, is that "the systematic growth of astronomy in the past 15 years has been the greatest single development in science—excepting possibly microbiology." Professor Morrison's new windows are those of radio and x-ray astronomy—the study of radiations higher and lower in frequency than those which are visible as light, which turn out to be reaching earth from both continuous and pulsing sources of remarkable distribution and intensity.

Two-thirds of the world's population has a diet nutritionally inadequate in one or more respects, said Nevin S. Scrimshaw, Head of the Department of Nutrition and Food Science. The problem of improving these people's lot is less technological than economic and political: much is known about dietary requirements and how to improve local food products by supplementing conventional protein sources with unconventional ones, and more data are accumulating constantly. For example, he said, research at M.I.T. has made it "a world center for research on single-cell protein sources;" the first chemical trials of single-cell protein began at M.I.T. two months ago. Are wholly synthetic foods practical? Not yet, said Dr. Scrimshaw, but research has now progressed so far that several groups of M.I.T student volunteers are now on diets of this kind, and the tests are proceeding successfully, said Dr. Scrimshaw.

When technology attacks urban problems, said John F. Collins, Visiting Professor of Urban Affairs at M.I.T., it encounters "new problems of inconstancy and human frailty," and this is one reason why conventional engineering and social solutions seem to have such little effect. For example, said Professor Collins, no simple subsidy program taken alone—or all taken together—has had success in providing housing for those with individual incomes at the $3,000 level. Now, he said, a group at M.I.T. is beginning a basic study of the national and local implications of past housing subsidy programs. Clearly, he said, before we decide in the future that "all we need is money," we must have "a real understanding of the social dynamics of our system, the interacting forces that shape our cities." "Central cities," declared Professor Collins, "simply cannot be left to the intuitive process of elected officials."

The future belongs to the computer *and* man, working as a team, said Proefssor Joseph C. R. Licklider, Director of M.I.T.'s Project MAC. Though it may have seemed so to some, said Professor Licklider, computers and people need not be hostile. Indeed, what people do least well computers do best, and vice versa. The truth of that statement will be clearer very soon, said Professor Licklider, because programming is now catching up with computing and we can begin to give proper emphasis to truly effective use of machines. People find effective interaction with computers "a very motivating thing," and on all these observations Professor Licklider based great optimism for the effectiveness of the new generations of men and machines together.

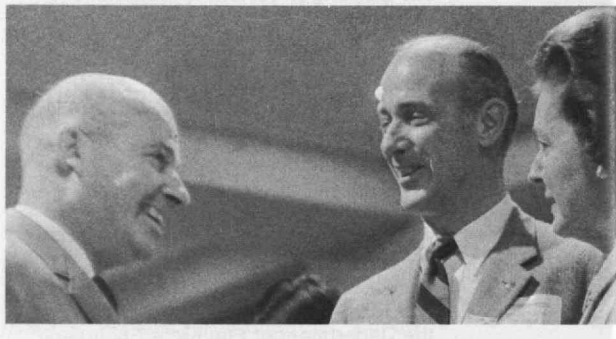
Concluding the meeting, President Johnson put these and other developments of modern technology into the context of national issues. "Educational institutions provide a testing of our ability to develop new knowledge and to apply it in our real world," he said and he cited the tradition of M.I.T. which goes back to the founder William Barton Rogers' emphasis of the "dignity of useful knowledge." Yet in its present environment, Philip H. Peters, '37, President of the Alumni Association, said, M.I.T. "faces the greatest challenges ever in my memory." He cited such issues as the lack of support in areas of major commitments, academic problems raised by the rapid growth of knowledge, and issues in fulfilling M.I.T.'s responsibilities for defense research.

Roscoe H. Smith, '23, and H. Arthur Zimmerman, '37, shared responsibility for the meeting as Chairman and Vice-Chairman of the Conference Committee, respectively. Committee members included John A. Bradner, '35, Daniel S. Connelly, '31, Robert S. Dirks, '57, H. Bruce Fabens, '44, Robert J. Fay, '42, Rutherford B. Harris, '37, Theodore K. Keith, Jr., '50, Elwood H. Koontz, '36, Stanley M. Proctor, '43, Walter A. Rajki, '51, Frederick W. Reuter, Jr., '38, and Oliver E. Seikel, '59.

Nobelist Khorana to M.I.T.

Har Gobind Khorana, a molecular biologist who shared the 1968 Nobel Prize in Medicine and Physiology, will join the M.I.T. faculty as Sloan Professor of Biology and Chemistry next year. He is widely known for research in deciphering the genetic code and in uncovering how genetic messages inscribed in the genes are translated into the structure of enzymes and other proteins.

Alumni filled the Cleveland Statler-Hilton's ballroom in October for an all-day regional conference on technology and human affairs. Among the principals in the photographs: President and Mrs. Howard W. Johnson (below); Roscoe H. Smith, '23, Chairman of the conference (center); Nevin S. Scrimshaw, Head of the M.I.T. Department of Nutrition and Food Science (right); Rutherford B. Harris, '37, President of the M.I.T. Club of Cleveland, with Philip H. Peters, '37, President of the Alumni Association, and Mrs. Peters; and Philip Morrison, M.I.T. Professor of Physics (bottom, right).



It was largely for the work in genetic coding that Professor Khorana shared the 1968 Nobel Prize with Dr. Robert W. Holley of the Salk Institute and Dr. Marshall W. Nirenberg of the National Institutes of Health. At the Enzyme Institute of the University of Wisconsin, Professor Khorana is now completing work toward the laboratory synthesis of an entire gene; Victor K. McElheny, Science Editor of the *Boston Globe,* reports that many biologists believe this work is "more important" than the earlier genetic research for which the Nobel Prize was awarded. Professor Khorana will continue this work at M.I.T. next year with several associates now at the University of Wisconsin.

Professor Khorana was born in 1922, in Raipur, India, and studied chemistry at the Universities of Punjab and of Liverpool.

Since 1948 he worked at the Federal Institute of Technology in Zurich, Switzerland, at Cambridge University, at the University of British Columbia (as Head of the Organic Chemistry Division), and at Rockefeller University before going to Wisconsin in 1960. He is a member of the National Academy of Sciences and holds the Merck Award of the Chemical Institute of Canada (1958) and the 1960 Gold Medal of the Professional Institute of the Public Service of Canada.

Environmental Research

James A. Fay, S.M.'47, Professor of Mechanical Engineering, is chairman of a new faculty committee to encourage M.I.T research and teaching related to environmental problems.

In announcing its appointment, Howard W. Johnson, President of M.I.T., said the new committee will "recommend policies and procedures needed to aid M.I.T. groups interested in dealing with environmental problems and provide information and advice on funding."

Fifteen members of the faculty have thus far been designated as members of the committee, and more will be added "as their interests become known," said President Johnson. The present members, in addition to Professor Fay, include Raymond F. Baddour, Sc.D.'51, Professor of Chemical Engineering; Paul W. Cook, Jr., Director of the Analytical Studies Group; Ralph H. Cross, III, Assistant Professor of Civil Engineering; David P. Hoult, '57, Associate Professor of Mechanical Engineering; Arthur T. Ippen, Ford Professor of Engineering (civil engineering); James C. Keck, Ford Professor of Engineering (mechanical engineering); Henry W. Kendall, Ph.D.'55, Professor of Physics; Jack L. Kerrebrock, Professor of Aeronautics and Astronautics; Jerome H. Milgram, '61, Assistant Professor of Naval Architecture; Michael Modell, '60, Assistant Professor of Chemical Engineering; John Ross, Head of the Department of Chemistry; Thomas K. Sherwood, Sc.D.'29, Professor of Chemical Engineering, Emeritus; Ethan R. Signer, Ph.D.'63, Associate Professor of Microbiology; Jeffrey I. Steinfeld, '62, Assistant Professor of Chemistry; and Gerald N. Wogan, Professor of Food Toxicology.

Entrepreneurship & Management for Young M.I.T. Alumni

Following on the success of the "pilot model" in Cambridge this fall (*see* Technology Review *for December, page 106-107*), four seminars on the problems of organizing and managing a successful new business enterprise will be conducted by M.I.T. clubs in four major cities this spring.

The cities and dates are: New York March 21 and 22, Washington April 4 and 5, Chicago April 18 and 19, and San Francisco May 2 and 3.

Each seminar will include presentations by senior M.I.T. alumni on such topics as technical entrepreneurship, finance, marketing, information systems, legal problems, technical development, and production. In addition there will be workshops in areas of special interest to young M.I.T. entrepreneurs. In each case, programs will be tailored to requirements of the region and its industry.

Preference in registration will be given to graduates in classes from 1955 through 1967 and to alumni refused registration in this fall's seminar at M.I.T. because of lack of space. The fee for the seminars, different in each city, will be about $40. Further details will reach alumni soon, and reservations in the meantime may be made through the Alumni Association headquarters in Cambridge.

Personnel Office Changes

Harold E. Dreyer, Ph.D.'52, formerly Personnel Officer for Benefits in the M.I.T. Office of Personnel Relations, has been named Personnel Director at the M.I.T. Instrumentation Laboratory, succeeding Jeremiah P. Callahan who resigned to accept a position in industry.

Alan J. Urquhart will replace Dr. Dreyer as M.I.T.'s Personnel Officer for Benefits, and Richard Finnagan has joined the staff of the M.I.T. Office of Personnel Relations to specialize in the recruitment and placement of minority personnel.

Dr. Dreyer has been with the Institute in various personnel capacities since 1951, one year before he completed work for the Ph.D. in industrial economics; he also holds the J.D. degree from the Suffolk University Law School (1964). Mr. Urquhart attended McGill University and Springfield College and has a background of 18 years in the life insurance industry, 14 of which were in field and home office management. Mr. Finnagan has been associated with community action and equal opportunity programs for many years, most recently as Placement Director and Liaison Officer for the Training Facility of the Raytheon Service Co. in Waltham, Mass.

Operations Research Director

John D. C. Little, '48, Professor of Management, has been named Director of the M.I.T. Operations Research Center, succeeding Philip M. Morse, Professor of Physics, who retired at the end of the 1968-69 academic year. Alvin W. Drake, '57, Associate Professor of Electrical Engineering, will continue as Associate Director.

Professor Little, who studied physics as an undergraduate, received the first Ph.D. degree ever granted by M.I.T. for a thesis in operations research—and probably the first degree of its kind in the world. He had returned to the Institute after a year at the General Electric Co.; and after two years as an operations analyst in the Army, Dr. Little was appointed to the faculty at Case Institute of Technology and then returned to M.I.T. in 1962.

At M.I.T., Dr. Little has been a member of the Interdepartmental Committee on Operations Research since 1962, head of the Marketing Group in the Sloan School since 1965, head of the Mathematical Methods Group since 1967, and Associate Editor of *Management Science* since 1967. His research as been in the areas of hydroelectric systems, queuing theory, traffic signal optimization, mathematical programming, marketing models and on-line models for managerial decision making.

Professor Morse, who has directed the Operations Research Center since its founding in 1953, is one of the pioneers of operations research, and he has recently played a leading role in extending the Center's activities to public systems. He began his career in the field during World War II while engaged in a program of submarine detection, and he was the first President of the Operations Research Society of America.

Toward a Pluralistic Community

A long M.I.T. tradition of "shower parties" for freshman dormitory residents on the night before the year's first quizzes in physics and mathematics led this fall to a very different kind of campus tension.

Following the incident, out of which a black student apparently came to feel a deliberate invasion of his privacy and racial bias in the campus press, Howard W. Johnson, President of the Institute, took two steps "to avoid, if possible, further misunderstanding:"

1. He asked the East Campus judicial committee and—if appropriate—the Dormitory Council and its judicial committee to investigate the circumstances of the incident and whatever "common law" may exist concerning hazing.
2. He asked Paul E. Gray, '54, Associate Provost, and others concerned with the Institute's effort to expand educational opportunities for blacks "to examine directly and immediately the serious problem of racial resentments and tensions on this campus."

"M.I.T. is a pluralistic community," wrote President Johnson. "Its value to each of us as a place in which to live and study depends in large measure on how much effort each of us invests to make that community work, to respect the dignity, individuality, and personal worth of every other person here."

When some 100 secondary school guidance counselors visited M.I.T. early this year they were told that "the whole way of engineering has changed." Engineering students are no longer willing to defer their political education until after an engineering education, said undergraduate speakers.

"The Art of Making Possible"

Student activism, communications by the "grapevine," rapid change, pass-fail, and even such leading statements as "you can get out of pressure by getting married"—all these failed to ruffle the equanimity of nearly 100 high and secondary school guidance counsellors, from 35 states and Puerto Rico, who were M.I.T.'s guests for a two-day conference this fall. It was rather as if they had heard it all before.

Even one of the visitor's questions about "How do you cope with the drug problem?" attracted few raised eyebrows. (J. Daniel Nyhart, M.I.T. Dean for Student Affairs, answered that M.I.T. does it informally, by counseling and by helping students to understand and help their classmates.)

There were smiles for Mrs. Louise Grochow, '70, who noted that co-eds have advantages: "You get extra favors," she said. "Every professor wants a girl in his class."

And about the advantages of pass-fail grading: "Instead of relying on examinations, professors must get to know their students," said Karen Wattel, '70, Secretary of the student government. Or on student-Institute relations: "The only time I've felt that M.I.T. was against me was on Registration Day."

The high school visitors seemed blasé. "We hear you talk with pride about activism, guidance, dormitories, and tutors—just like every other school. But what is really special about M.I.T.?" one asked. "How do you integrate a scientific education with all these committees, communications, and social action?" When his turn came, Howard W. Johnson, President of M.I.T., attempted the answer by citing the philosophy of the Institute's founder, William Barton Rogers. "Knowledge is made to be used," he said. "At no time in history has the need for creative work in technology been so great. But that work is useless without an understanding of how people use the result.

"M.I.T. students expect that what they learn here will make a difference in the way men work and live," President Johnson said. "There is a long tradition of 'the art of making possible' at M.I.T.," he told his school audience, "and there is immense commitment to this goal."

"We've been reading our mail, too," said Arthur D. Horton, Director of Development at Princeton University, who was a guest "consultant" at the meeting of the Alumni Fund Board. He thinks that because of current campus events "there is not quite the same enthusiasm" among alumni working for their alma mater; in response, he said, Princeton has been giving "increasing emphasis on face-to-face communications between the college and the alumni throughout the U.S.

Polarization and Boredom

What happened to M.I.T. in November, when the November Action Committee tried by near-violent protests to focus the community's attention on the issues of war research and the Vietnam war (*see* Technology Review *for December, pp. 96B ff.*)?

It's still too early to be sure, Paul E. Gray, '54, Associate Provost, told the Alumni Fund Board early this winter. But these are the first suggestions:

1. Though the events of November 4 to 6 held "enormous potential for a decisive, disrupting action," in retrospect it appears that the November Action was "largely a failure as an effort to build a base of support within the M.I.T. community" for a radical movement here.

2. Since the November Action a good many members of the M.I.T. community seem to show a growing disenchantment —ennui, if you will—with the repeated generalizations and oversimplifications of the radical left.

3. But members of the community are at the same time displaying somewhat stronger feelings—increasing polarization —about the issues with which M.I.T. is confronted, such as its future role in defense research, the relevance of its educational programs to social needs, and the like. Whether because of the November 4 to 6 events or not, there is a new desire to debate and resolve these issues.

4. The N.A.C. promised to "raise the cost of defense research at M.I.T. until the cost of keeping it is higher than the cost of ending it." They did indeed raise the cost, said Professor Gray, but "in ways counterproductive to their stated purposes." The problems raised by the N.A.C.'s threats were so compelling to the Institute's administration, he explained, that for the week of concern essentially all of M.I.T.'s efforts to gain more support for the non-defense research which N.A.C. was asking the Institute to emphasize had to be temporarily shelved.

Radical protest such as M.I.T. experienced in November "will likely be a manifestation of the college experience for several years," said Professor Gray, and one of the Institute's problems now is to find a way "to operate normally within this context."

That other issues—perhaps even more substantive—also confront M.I.T. was made clear during informal remarks to the Alumni Fund Board by Howard W. Johnson, President of M.I.T. "At a time when the 'man on the street' has grave doubts about what is happening on college campuses," he said, "every private university I know is under great financial pressure. The handwriting is on the wall in terms of the problems we face in attempting to provide an effective higher education and fulfill our growing obligations to society in the face of today's inflation."

Toward an Experimental Library

A $150,000 grant to M.I.T. will provide two-year support of the Institute's Engineering Library as an experimental model incorporating major new technological developments.

The Council on Library Resources thus continues support of experiments and equipment development intended to provide bases for the design of future research library systems. The Engineering Library, the model for the experiments, has been designed as a "transitional library" where new services and newly developed computer equipment will be utilized within a facility which also provides traditional library services.

Included in the activities to be undertaken under the new grant are tests of point-of-use instructional materials, devices, and techniques to help library users with traditional materials and with access to new forms of text and graphic storage; methods for using digitally recorded bibliographic data bases located outside M.I.T.; measurements of user preferences for certain types of text reproduction; and visitor programs to enable others to see and evaluate the operation of this transitional library.

The work will be carried out by M.I.T.'s Project Intrex (*In*formation *Tr*ansfer *Ex*periments) under the direction of Carl F. J. Overhage, Professor of Engineering. The Engineering Library, which serves both faculty and students, opened late this fall following physical remodeling at a cost of nearly $2 million.

$13 Million for Oceanography

The graduate program and related research at the Woods Hole Oceanographic Institution is benefitting from gifts of $13 million announced this fall by Paul M. Fye, President of W.H.O.I. Of the total, $8 million was given by J. Seward Johnson, Director and Chairman of the Finance Committee of Johnson and Johnson, and $5 million by W. Van Alan Clark, Honorary Chairman of the Board of Avon Products, Inc.

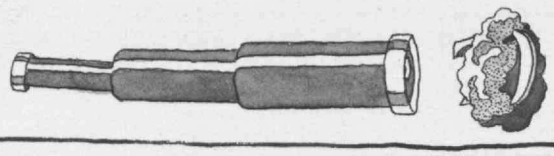
The funds will provide endowment to support W.H.O.I.'s new program jointly with M.I.T. leading to the Ph.D. degree in oceanography from the two institutions. The first W.H.O.I.-M.I.T. degree was awarded this fall to W. Frank Bohlen, a member of the W.H.O.I. staff from 1962 to 1963 and again in 1965 before and while registered for M.I.T. graduate work.

The $13 million more than doubles W.H.O.I.'s endowment funds, according to Dr. Fye's announcement. By their generosity, he said, the two donors assured "the long-range continuation of our education program for training future generations of ocean scientists."

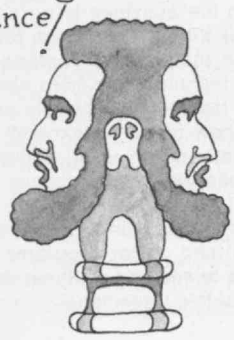
Kane on M.I.T.

Henry B. Kane, '24
Director of the M.I.T. Alumni Fund, Emeritus

JANUARY 69

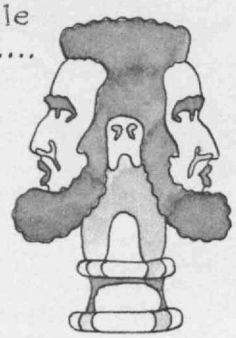


Well, there goes the last of the '60s ~ and good riddance!

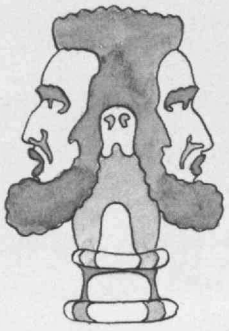


It was that bad, Jan?

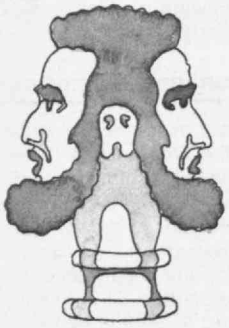
Are you kidding? What with Viet Nam and the Middle East....



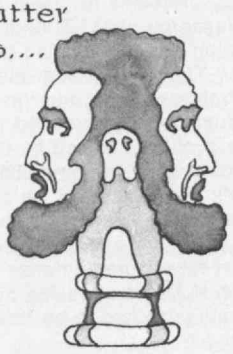
ABM and MIRV and highjacked planes....



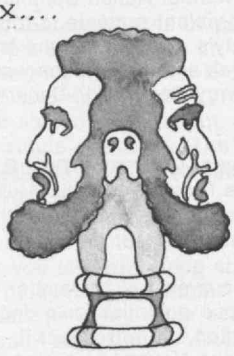
student takeovers, LSD and pot....



pornography and the "smartness" of gutter words....

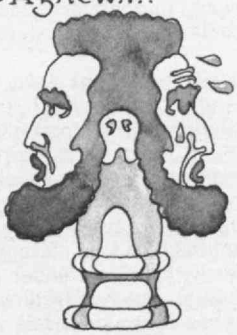


rampant inflation and the 10% surtax....



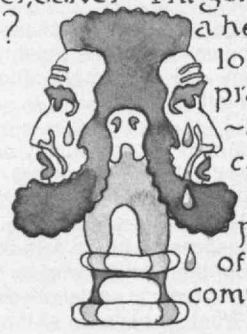
oil spills and hurricanes and earthquakes....

air and water and noise pollution and Spiro Agnew....



but enough of it was a bad, bad '69. What do you see for 1970, Jan, a better, saner world?

Well Jan, it's a bit cloudy ~ let's just say I'm gonna do a helluva lot of praying ~ and I can do with plenty of company!



H·B·KANE

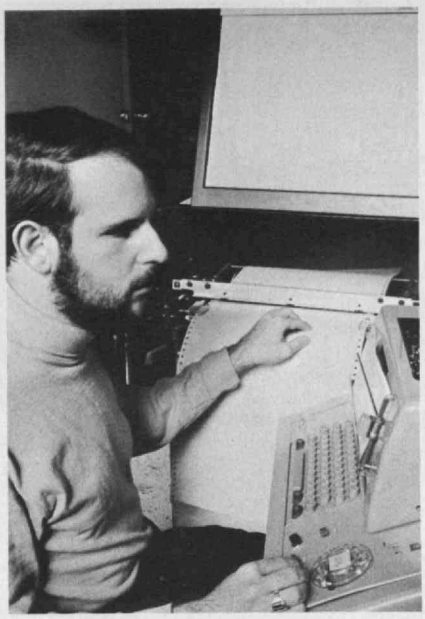
Computing and the Blind: A Whole New Range of Power

"When I am on the computer," says Michael L. Lichstein, graduate student in economics, "I am on an even par with everyone else."

Most people would give that statement one particular meaning; but when they learn that Mr. Lichstein is blind they might interpret it very differently.

Mr. Lichstein has been using a braille input-output computer terminal developed in the M.I.T. Center for Sensory Aids Evaluation and Development since last June, holding down a job as systems analyst on a large computer program in econometrics. His computer terminal includes a standard teletypewriter and a braille embosser. He uses touch typing on a teletyper keyboard, and his back-and-forth messages with the computer appear simultaneously in print on the teletypewriter and for him to read in braille on the embosser; the equipment he uses is an extension of earlier computer-based programs to translate printed words into braille developed at M.I.T., and the Sensory Aids Center hopes it is the beginning of a whole new range of professional opportunities for the blind.

Mr. Lichstein says he literally cannot overestimate the value of the system to him. "Not only is it possible to model and estimate systems of equations," he says, "but a tremendous quantity of data is stored in the system and kept updated. This means that it is now possible for the blind investigator to carry on his research independently or as a fully functional member of a group. The tedious problems of data collection, which are literally impossible for a blind individual, are to a large extent solved," he says.



Michael L. Lichstein, blind graduate student in economics, uses a teletypewriter (right) and a high-speed braille embosser developed in the Department of Mechanical Engineering at M.I.T. to communicate with a time-shared computer system. The embosser provides him with braille information as quickly as the conventional teletypewriter output is activated from the computer.

Dynamics of Coercion and Change

Don't think that only campus "radicals" make "non-negotiable" demands. When an institution's governing body declares that it shall meet only privately, behind closed doors, that too—as seen by students—is a non-negotiable demand. And there is no place for either kind of "demand" at the modern university, said Marvin S. Keshner, '71, at the last pre-holidays meeting of the Alumni Advisory Council on November 24.

Dr. Benson R. Snyder, Dean for Institute Relations, reassured the alumni that, in comparison which many universities today, M.I.T. has had very few "non-negotiable" demands of either kind. Indeed, though the "radicals' " statements in advance of the November Action (*see* Technology Review *for December, pages 96B ff.*). suggested coercion and confrontation, it may well turn out that M.I.T. was "kicked hard enough to get us moving but not hard enough to hurt," he said.

The result may be an increase of commitment to the central concerns of education throughout the M.I.T. community. "It is naive to think that we have won a battle," Dr. Snyder warned. "Our problem now is to find and nurture reliable processes by which we as an institution can chart our course in a period which must involve rapid change."

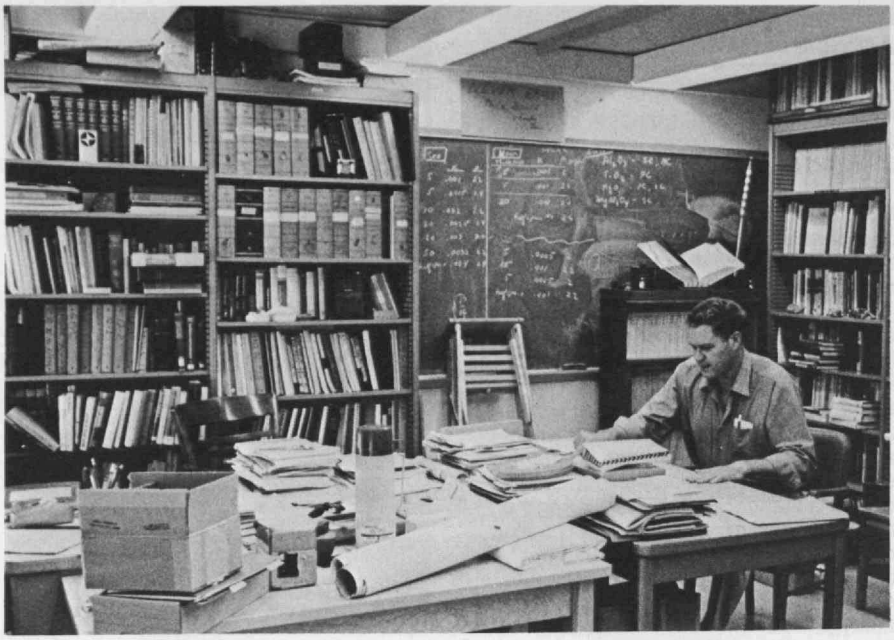
Another facet of the issues before M.I.T. was described by Max C. Deibert, Sc.D. '64, Assistant Professor of Chemical Engineering: we are grappling, he said, with a question which is almost "religious" in character. If human life is nothing more than physics and chemistry, then we know its qualities can be changed. But we know that a broader set of assumptions and philosophies is necessary for a scientific enterprise. Because of this, said Professor Diebert, "for a significant number of students today there is no reference point"—no common point of assurance, no obvious way of gaining identity.

Yes, said Charles E. Mann, '72, we have no point of common understanding because we all have different goals. We can never again expect that everyone in the M.I.T. community will find a common ideology on which they can agree. "But if we can learn tolerance," he said, "maybe we can hold the place together and even go somewhere with it."

Faculty Appointments

Six alumni have been named to new positions on the M.I.T. faculty; their appointments are: Harry S. Colburn, '63, Assistant Professor (and Postdoctoral Fellow) in Electrical Engineering; John W. Hafstrom, '65, Assistant Professor in Metallurgy and Materials Science; Richard C. Larson, '65, Assistant Professor (and Postdoctoral Fellow) in Electrical Engineering; Amedeo R. Odoni, '65, Assistant Professor in Civil Engineering; Donald L. Smith, '65, Assistant Professor in Chemical Engineering; and Nam P. Suh, '59, Associate Professor in Mechanical Engineering.

Referring to November events at M.I.T., Marvin S. Keshner, '71, told members of the Alumni Advisory Council in November that "it's possible the actions of the 'left' on this campus have in fact caused us to think and act more effectively, that they have kicked us hard enough to get us moving but not hard enough to get us hurt."



Professor Gene Simmons, shown here in his office at M.I.T., is also the first Chief Scientist of N.A.S.A.'s Manned Spacecraft Center in Houston. His task is to optimize the balance between science and engineering in the Apollo program, within the present budget. (Photo: Richard Koolish)

Dubbs Visiting Professor

J. Theodoor G. Overbeek, a distinguished Dutch physical chemist who is a member of the faculty at the University of Utrecht, is the 1969-70 Visiting Carbon P. Dubbs Professor in the M.I.T. Department of Chemical Engineering; he was in residence on the campus for four weeks this fall and will return for a similar period, from April 18 to May 11, this spring.

In announcing the appointment, Raymond L. Bisplinghoff, Dean of the M.I.T. School of Engineering, said that Professor Overbeek "is one of the outstanding authorities on surface chemistry and surface physics in the free world." In addition to lectures and seminars at M.I.T., Dr. Overbeek will be making video tapes for the Department of Chemical Engineering's educational program in surface phenomena.

Dr. Overbeek has been at M.I.T. on two previous occasions—as Visiting Professor in Department of Metallurgy in 1952-53 and as Visiting Professor in the Department of Chemical Engineering in 1966-67. He has been Professor of Physical Chemistry at Utrecht since 1946, having previously served on the research staff of Philip's Glowlampworks in Eindhoven and at Brussels University. The Dubbs Professorship which Dr. Overbeek holds was established by his descendents in honor of Carbon P. Dubbs, who made important inventions in the field of petroleum refining.

McCulloch Memorial Fund

Before his death, the late Dr. Warren S. McCulloch, a member of the staff of the M.I.T. Research Laboratory of Electronics for 17 years (*see* Technology Review *for December, page 101*), had established a fund to provide travel expenses for students and staff who could not otherwise attend important professional meetings. Now, at the suggestion of Mrs. McCulloch, a McCulloch Memorial Fund has been established at M.I.T. to continue the tradition, and contributions may be made to the Treasurer of the Institute.

That They May Understand One Another's Speech

Of the gaps left by the resignation of a number of scientists from the National Aeronautical and Space Administration, the most important has been filled by Professor Gene Simmons, an M.I.T. geophysicist, who has been appointed to the new post of Chief Scientist, Manned Spacecraft Center, Houston. He has been working with Houston for about as long as he has been at M.I.T.—four years—and most recently has been subjecting lunar samples from Apollo 11 to experiments on physical properties (thermal and electrical conductivity, velocities of elastic waves, etc.).

A large number of scientists, of course, have been studying the Apollo specimens, but Professor Simmons is also among the rather small number who have been closely involved with Houston as advisers on the scientific content of the lunar expeditions. It was from these—who understand life at Houston—that a leader had to be found when Dr. Wilmot N. Hess, Director of Science and Applications, resigned.

The solution was to make Dr. Simmons responsible for overall direction of Apollo science—necessitating his physical presence at Houston just one day a week—and to leave the day-to-day administration to Hess's former deputy, Anthony Calio, who is now the Director of Science and Applications.

Simmons' day at Houston is Friday, the day when the Configuration Control Board meets to approve changes in the equipment that goes to the moon. His voice is thus heard where it counts, and it is an informed voice. Understanding the engineering and financial constraints of manned lunar exploration, and working within them, his job is to decide how to insert the greatest possible amount of real science. Professor Simmons gives the impression of being a realist. Once it is recognized that Apollo is an engineering operation, best approached on its own terms, then "if a good case can be made for doing something [scientific], it gets done." Example: the stereoscopic close-up camera which brought home scientifically valuable pictures of the lunar surface from Apollo 11 was carried because the engineers, not the scientists, were persuaded that it was a good idea.

Clearly, much science-versus-engineering tension has been in evidence recently (*see "Nary a Scientist Aboard", by Victor Cohn,* Technology Review, *October/November 1969, pp. 14-15*), but Simmons thinks N.A.S.A. is sincere in its attempts to give science a fair share of the action. "If I didn't," he

says, "I wouldn't have taken the job." For instance, the "rover vehicle" that geologists would like for carrying explorers and samples farther than an astronaut can walk is not out of the question. N.A.S.A. is considering how to get a small buggy on to—at the time of writing—Apollo 13. (In addition, Boeing has now received a $19 million contract to build "rovers" for the last four Apollo missions, i.e. for use starting mid-1971.) The prospects for "scientist-astronauts" are getting better, but Dr. Simmons the realist accepts that for the present the crews still have to be test-pilots.

And as to the question of slowing down the launching schedule so that later Apollo experiments get the greatest possible guidance from what is learned in earlier ones, we have to realize, says Dr. Simmons, that the program has a massive annual cost, not greatly dependent on how many ships are transferred from the ground to outer space. The longer N.A.S.A. takes getting a given number of vehicles to the moon, the more it costs. Thus, one tries to optimize the amount of science done per million dollars. Perhaps a cease-fire between space scientists and engineer-economists will be brought about by a man who is able to talk comprehensibly with both.

General Motors Makes Tanks!

"In my innocence I thought General Motors made motor cars, but they make tanks! And Chrysler, which in my innocence I thought made motor cars, is making 175 mm. shells!" Nobel Laureate George Wald, Professor of Biology at Harvard, came back this fall to the M.I.T. podium where last March 4 he gave a widely publicized address about the young generation. This time, although the tone was the same, the theme was different: the defense business—"the business of death," he called it.

In his unique, sermonlike style, Professor Wald summoned the facts of his case. "There is an interlocking directorate" of military and industrial leaders, he said, who together perpetuate "the business of defense—the biggest business in the world."

"Pentagonism"—the business of making weapons and then declaring them obsolete ("dumping")—is more profitable than "old-style imperialism," because the combined gross national products of Cambodia, Laos, Thailand, North Vietnam and South Vietnam (what the U.S. would gain by a colonial-style "takeover") are $10.1 billion, *less* than the public money now used in the contracts for the proposed anti-ballistic missile (A.B.M.) system.

Law students enroll in Reserve Officer Training Corps programs so that, if drafted, they will be stationed in a judge advocate's office. But the legal profession supplies the largest share of the nation's Congressmen, and this means that 170-odd members of the U.S. Congress have served or are serving in the military reserves of the armed forces.

Professor Wald also told the story of a professor friend who, touring a nuclear submarine, found his guides, in military uniform, saluting a company official in civilian clothes. They explained to the astonished professor that the man behind the desk was their former commander.

Secretary of Defense Melvin Laird's proposed "sidelining" of B-58 bombers and putting warships in mothballs will actually weaken American defenses, said Professor Wald. But simple cutbacks in on-going contracts, which are unaffected by Pentagon economy plans, would not.

"I want to be defended." Professor Wald declared. But would we not be better defended if the government invested in research to prevent massive power failures—such as the 1965 Northeast blackout—instead of building more new-but-obsolete weapons, he wondered.

Individuals Noteworthy

Joseph Morgan, Ph.D.'37, to Director of Research Coordination, Texas Christian University . . . **E. Robert de Luccia,** '27, Senior Vice-President and Chief Engineer of Pacific Power and Light Co., to President of the Oregon Graduate Center . . . **Lee C. Eaglegon,** '44, to Professor and Head of the Department of Chemical Engineering at Pennsylvania State University, succeeding **Merrell R. Fenske,** Sc.D.'28 . . . **John F. Henry,** '53, to Head of the Department of Management in School of Business, Auburn University.

Joseph Casanova, Jr., '53, to Professor of Chemistry at the California State College, Los Angeles . . . **Matthew Sands** Ph.D.'48, to Vice-Chancellor—Sciences of the University of California (Santa Cruz) . . . **Martin Schetzen,** Sc.D.'61, and **Walter C. Schwab,** '51, both to Professor of Electrical Engineering, Northeastern University . . . **Lee C. Eagleton,** '44, to Professor of Chemical Engineering and Head of the Department at Pennsylvania State University . . . **Forrest T. Meiere,** Ph.D.'64, to Chairman of the Physics Section, 38th Street Campus, Indiana University—Purdue University at Indianapolis.

John Hovorka, Sc.D.'61, to Chairman of the Division of Science and Mathematics and Professor of Physics at Curry College, Milton, Mass. . . . **William K. Widger, Jr.,** Sc.D.'49, Professor of Physics at Drexel Institute of Technology, to President of Belknap College, Center Harbor, N.H. . . . **W. Henry Tucker,** Sc.D.'47, to Chairman of the Department of Chemistry and Chemical Engineering at Tri-State College, Angola, Ind. . . . **Donald R. Washington,** Ph.D.'61, to Professor of Civil Engineering and Director of the Water Resources Center, Ohio State University . . . **David A. Aikens,** Ph.D.'60, to Professor of Chemistry, Rensselaer Polytechnic Institute.

Louis H. Roddis, Jr., S.M.'44, Vice Chairman of Consolidated Edison Company, to President of the American Nuclear Society . . . **Pei-Moo Ku,** '42, Director of Aerospace Propulsion Research at the Southwest Research Institute, to President of the American Society of Lubrication Engineers . . . **George W. Clark,** '41, Manager of Lighting Equipment Design for Sylvania's Lighting Equipment Division, to Treasurer of the Illuminating Engineering Society.

Donald M. Black, Ph.D.'47, Director of Commercial Development, Industrial Chemicals Division, Geigy Chemical Corporation, to President of the Chemical Marketing Research Association . . . **Robert C. Seamans, Jr.,** Sc.D.'51, Secretary of the U.S. Air Force, an Honorary Fellow of the American Institute of Aeronautics and Astronautics . . . **Dr. Robert N. Smith,** S.M.'45, to President of the Ohio State Medical Association.

Mexican Fiesta and Expo '70 Tour

Dr. and Mrs. James R. Killian, Jr. ('26), are to be the honored guests for this year's 22nd Annual M.I.T. Fiesta in Mexico City, March 12-14, 1970. In addition to the traditional program of museum visits, get-togethers, *Charreada* and climactic *Noche Mexicana,* the Club promises time during the three-day Fiesta for sightseeing on your own, shopping and "just plain resting."

Registration for a limited attendance of 100 alumni and spouses is open now; contact the M.I.T. Club of Mexico City, Reforma 116-804, Mexico 6, D.F. Once in Mexico City the total cost for all events on the program is $65 per person including transportation and meals.

The M.I.T. Alumni Center of New York has tentative plans for two spring tours for M.I.T. alumni; those interested in this experimental program are invited to write at once for further details to James N. Phinney, Executive Secretary of the Center, Suite 1828, 295 Madison Avenue, New York 10017. One tour, featuring Expo '70, is planned to leave New York about May 14, returning about June 6; it will include visits to Taiwan, Hong Kong, Bangkok, Singapore, Manila, and Hawaii as well as Japan. The cost, including luxury accommodations and most meals, is estimated at $1750 per person.

Twelve days in Spain and Portugal are included under the tentative plans for the second tour, scheduled to depart from New York about April 1.

Alumni Calendar

Atlanta—February 3, Tuesday, 8 p.m.—M.I.T. Symphony Orchestra performs at the High Museum.

Boston—January 8, Thursday, 12:00 noon—Luncheon, Aquarium Restaurant, 100 Atlantic Avenue. Speaker: Walter A. Rosenblith, Associate Provost. Topic: The restlessness in higher education.

Cambridge—February 6 and 7, Friday and Saturday, commencing at 4:00 p.m. Friday—Conference for Club Presidents. Howard W. Johnson, President, and other Institute and faculty leaders will join the Friday session and dinner at the M.I.T. Faculty Club. Saturday meetings will begin at 9 a.m. at the Center for Advanced Engineering Studies, Building 9; Harold W. Fisher, '27, Chairman of the Alumni Advisory Board, will speak at the luncheon meeting at the Student Center Mezzanine Lounge. Two officers from each Club are invited.

Dallas—January 29, Thursday, 6:30 p.m.—Dinner, Executive Inn. Speaker: William F. Pounds, Dean, Sloan School of Management. Topic: Defense-related research at M.I.T.—a confrontation issue.

Denver—February 5, Thursday—Speaker: Jerome B. Weisner, Provost. Topic: the role of the technical university in higher education.

Fairfield, Conn.—January 21, Wednesday, 6:15 p.m.—Dinner, Holiday Inn, Darien. Speaker: Dr. Jack W. Dunlap of Dunlap & Associates. Topic: Creativity.

Houston—January 28, Wednesday, 6:30 p.m.—Dinner, Briar Club, Speaker: William F. Pounds, Dean, Sloan School of Management. Topic: Defense-related research at M.I.T.—a confrontation issue.

Long Island—February 4, Wednesday—Annual beer party; undergraduates home on mid-term vacation welcomed.

Los Angeles—February 1, Sunday, 3:00 P.M.— Annual meeting and elections, Roger Young Center, 936 West Washington Blvd. Speaker: Walter A. Rosenblith, Associate Provost. Topic: The restlessness in higher education.

Miami—January 29, Thursday, 6:00 p.m.—Dinner, Columbus Hotel. Speaker: Dr. Robert S. Lees, Director, M.I.T. Clinical Research Center, Topic: An approach to the causes of coronary heart disease.

Newark—January 27, Tuesday, 7:00 p.m.—Eastman Kodak Tour, Fair Lawn; refreshments will be served.

Philadelphia—January 13, Tuesday, 6:15 p.m.—Dinner, University of Pennsylvania Faculty Club. Speaker: Walter A. Rosenblith, Provost. Topic: The restlessness in higher education.

San Diego—February 3, Tuesday, 8:00 p.m.—Club meeting. M.I.T. Logarythms.

San Francisco—February 4, Wesnesday—Club meeting. M.I.T. Logarythms.

Washington, D.C.—January 13, Tuesday, 6:15 p.m.—Dinner, University Club. Speaker: Jay W. Forrester, S.M.'45, Professor of Management. Topic: Dynamic analysis for designing improved social systems.

Alumni Deceased

George E. Harkness, '96 September 2, 1969
Willard B. Nelson, '98, August 7, 1969
John J. Dooley, '03, November 30,1968
Fred P. Blair, '08, February 13, 1969
H. Daland Chandler, '08, January 11, 1969*
John Tyler, '08, June 14, 1969
Philip Covitt, '14, June 2, 1969
Ralph D. Weyerbacher, '14, July 13, 1969
Charles H. Hamill, '16, October 5, 1969
C. Dix Proctor, '17, December 13, 1969
Jacob Young, '18, n.d.
Stewart P. Coleman, '21, November 13, 1969
Platt C. Benedict, '22, September 28, 1969
George A. Nelson, '25, November 8, 1969
Richard W. Davy, '27, June 7, 1969
Donald Hawkes Spitzli, '27, August 16, 1969*
Edward D. True, '27, November 15, 1969
Thomas H. Campbell, '38, September 2, 1969
*Further information in Class Review.

Brewer Engineering Laboratories Inc.

Consulting Engineers

Experimental Stress Analysis, Theoretical Stress Analysis, Vibration Testing and Analysis, Specialized Electro-Mechanical Load Cells and Systems, Structural Model Testing and Fabrication, Strain Gage Conditioning and Monitoring Equipment.

G.A. Brewer '38,

Marion, Massachusetts 02738
(617) 748-0103

Capitol Engineering Corporation

Consulting Civil Engineers

Robert E. Smith '41,
Edward W. Boggs '56

Dillsburg, Pennsylvania 17019

Cleverdon, Varney and Pike

Consulting Engineers

Structural, Electrical, Civil, Heating and Ventilating, Air Conditioning, Plumbing

112 Shawmut Ave.
Boston, Massachusetts
02118

Charles Nelson Debes Associates, Inc.

Engineers and Consultants

Structural, Electrical, Mechanical, Acoustical, Industrial, Commercial and Municipal Projects

C.N. Debes '35

915 East State Street
Rockford, Illinois

Fabric Research Laboratories Inc.

Research, Development, and Consultation in the Fields of Fibrous, Organic, and Related Materials

W.J. Hamburger '21
E.R. Kaswell '39, K.R. Fox '40,
M.M. Platt '42
G.A.M. Butterworth '61

1000 Providence Highway
(At Route 128 and US 1 Interchange)
Dedham, Massachusetts

Fay, Spofford & Thorndike, Inc.

Engineers

Boston, Massachusetts

Haley & Aldrich, Inc.

Consulting Soil Engineers

Foundation Systems Engineering
Engineering Geology—Seismic Surveys
Site Evaluation & Development
Consultation for Design & Construction
Earth Dam Design
H. P. Aldrich, Jr. '47 D. E. Reed '64
M. C. Murphy '51 J. J. Rixner '67
W. H. McTigue '54

238 Main Street
Cambridge, Massachusetts 02142

Jackson & Moreland

Engineers and Consultants

Division of United Engineers & Constructors, Inc.

Boston, Massachusetts

Kuljian

Engineers·Constructors
Utility-Industrial-Public Works
Power Plants (Nuclear·Fossil·Hydro),
Transmission Systems (HV & EHV), Industrial & Processing Plants, Highways & Expressways, Airports & Facilities, Government & Institutional Buildings, Military Installations
H.A. Kuljian '19, E.J. Healy '24
A.H. Kuljian '48
1845 Walnut Street
Phila., Pa. 19103 Tel.: (215) 561-5300

Harold A. McCrensky Associates, Inc.

Management Consultants

Work Standards; Incentive Plans; Management Controls; Standard Costs

H. A. McCrensky '38, President
J. L. Gould HBS'37, Vice President
G. Beesley '39, Vice President
H. E. Jans '52, Senior Consultant

Park Square Building
31 St. James Avenue
Boston, Mass. 02116
Telephone: 617-542-2640

Metcalf & Eddy, Inc. Engineers

Boston • New York
Palo Alto • Cincinnati

Engineers and Consultants
to Government and Industry

Water and Air Pollution Control
Water Supply and Waste Disposal
Transportation Facilities
Community Planning and
Urban Renewal

Mueser, Rutledge, Wentworth & Johnston

Consulting Engineers

Foundations for Buildings, Bridges and Dams-Tunnels-Bulkheads-Marine Structures-Soil Studies and Tests-Reports, Design and Supervision

William H. Mueser '22,
Philip C. Rutledge '33

415 Madison Avenue
New York, New York 10017

Maurice A. Reidy Engineers

Foundations and Soil Mechanics

Structural Designs, Buildings, Bridges

101 Tremont Street
Boston, Massachusetts 02108

Technology International Corporation

Applied Science
Technology Transfer

Boston and Bedford
Massachusetts
Telephone: (617) 275-8424
Cable Address: INTECH

Paul E. Dutelle, Inc.

Roofers and
Sheet Metal Craftsmen

153 Pearl Street
Newton, Massachusetts
02158

Swindell-Dressler Company

A Division of Pullman Incorporated

Engineers

Civil and Public Works—Transportation Systems—Industrial Facilities

441 Smithfield Street
Pittsburgh, Pennsylvania
15222

Charleston, West Virginia—Harrisburg, Pennsylvania—Chicago, Illinois

Syska & Hennessy, Inc.

Engineers

Design-Consultation-Reports
Mechanical-Electrical-Sanitary
Elevator and Materials Handling

John F. Hennessy '24,
John F. Hennessy, Jr. '51

144 East 39 Street
New York, New York
10016

1720 Eye Street, N.W.
Washington, D. C.
20006

Lord Electric Company Inc.

Electric Contractors
to the Nation
Since 1895

New York N.Y., Medford, Mass.
Chicago, Pittsburgh, Portland, Ore.
Los Angeles, Richland, Wash.
San Francisco, San Juan, P.R.

Medford Office:
4080 Mystic Valley Parkway
(617) 396-9110

Science/ Engineering Alumni Magazines

Advertisers can reach
the alumni of 32 major
universities with a high
percentage of science and
engineering graduates
at discounted rates

For details write:
American Alumni Magazines
50 East 42nd Street
New York, New York
10017

Chas. T. Main, Inc.

Engineers

Studies and Reports
Design
Construction Management

441 Stuart Street
Boston, Massachusetts 02116
617/262-3200

1301 E. Morehead Street
Charlotte, North Carolina 28204
704/375-1735

Creative Professional Management, Inc.

Management Consultants

Quality Control
Manufacturing
Mechanization
Professional Placement

Wakefield, Mass.
(617) 245-8444

Polysciences, Inc.

Research, Development,
and Consultation in the
Fields of Polymers,
Monomers, Life Sciences,
and Medical Plastics.

B. David Halpern '43
Conrad Grundlehner '64

Paul Valley
Industrial Park
Warrington, Pa.
(North of Phila.)
(215) 343-6484

SPECIAL REDUCED RATES FOR M.I.T. ALUMNI

SIXTH ANNUAL TOUR PROGRAM—1970

This unique program of tours is offered to alumni of Harvard, Yale, Princeton and M.I.T. and their families. The tours are based on special reduced air fares which offer savings of hundreds of dollars on air travel. The tour to India, for example, is based on a special fare, available only to groups and only in conjunction with a tour, which is almost $400 less than the regular air fare. Special rates have also been obtained from hotels and sightseeing companies. Air travel is on regularly scheduled jet flights of major airlines.

The tour program covers four areas where those who might otherwise prefer to travel independently will find it advantageous to travel with a group. The itineraries have been carefully constructed to combine the freedom of individual travel with the convenience and saving of group travel. There is an avoidance of regimentation and an emphasis on leisure time, while a comprehensive program of sightseeing ensures a visit to all major points of interest. Hotel reservations are made as much as a year and a half in advance to ensure the finest in accommodations.

Preliminary information concerning the 1970 tour program is presented below. Definitive information and tour brochures will be available shortly.

THE ORIENT

30 DAYS $1649

1970 will mark the sixth consecutive year of operation for this fine tour, which offers the true highlights of the Orient at a sensible and realistic pace. As a special attraction, spring and summer departures will include a visit to the **"EXPO 70" World's Fair** in Osaka. Twelve days will be spent in **JAPAN,** divided between **TOKYO,** the **FUJI-HAKONE NATIONAL PARK,** and the ancient "classical" city of **KYOTO,** with excursions to **NARA** and **NIKKO.** A further highlight will be a comprehensive visit to the famous ruins of **ANGKOR WAT** in Cambodia, together with visits of 4 to 5 days in **BANGKOK** and **HONG KONG** and a shorter visit to **SINGAPORE.** Optional pre and post tour stops may be made in **HONOLULU** and the **WEST COAST** at no additional air fare. A complete program of sightseeing will include all major points of interest. Features range from a tour of the canals and floating markets of Bangkok and an authentic Javanese "Rijsttafel" dinner in Singapore to a launch tour of Hong Kong Harbor at sunset and a trip on the ultra-modern 125 mph express trains of Japan. Most tour dates include outstanding seasonal attractions in Japan, such as the spring cherry blossoms and beautiful autumn leaves and some of the greatest annual festivals in the Far East. Total cost is **$1649** from **California, $1819** from **Chicago, $1887** from **New York.** Special rates from other cities. Departures in March, April, June, July, September and October, 1970.

INDIA

Including NEPAL and PERSIA

28 DAYS $1699

An unusual opportunity to see the diverse and fascinating subcontinent of India, together with the once-forbidden kingdom of Nepal and the rarely-seen splendors of ancient Persia. Here is India from the mighty Himalayas to the palm-fringed Bay of Bengal: the great seaport of **BOMBAY;** the magnificent cave temples of **AJANTA** and **ELLORA,** whose thousand year old frescoes are among the outstanding achievements of Indian art; the unique "lake city" of **UDAIPUR;** the walled "pink city" of **JAIPUR** with an elephant ride at Amber Fort; **AGRA,** with the Taj Mahal and other celebrated monuments of the Moghul period such as the Agra Fort and the fabulous deserted city of Fatehpur Sikri; the holy city of **BANARAS** on the sacred river Ganges; the industrial city of **CALCUTTA;** a thrilling flight into the Himalayas to **KATHMANDU,** capital of **NEPAL,** where ancient palaces and temples abound in a land still relatively untouched by modern civilization; the great capital of **NEW DELHI;** and the fabled beauty of the **VALE OF KASHMIR** amid the snow-clad Himalayas. **PERSIA** (Iran) includes the great 5th century B.C. capital of Darius and Xerxes at **PERSEPOLIS;** the fabled Persian Renaissance city of **ISFAHAN** with its 16th century palaces, gardens, bazaar, and famous tiled mosques; and **TEHERAN.** Outstanding accommodations include hotels that once were palaces of Maharajas and luxurious houseboats on Dal Lake in Kashmir. Total cost is **$1699** from **New York.** Departures in February, August and October, 1970.

AEGEAN ADVENTURE

21 DAYS $1299

This original itinerary explores in depth the magnificent scenic, cultural and historic attractions of Greece, the Aegean, and Asia Minor—not only the major cities but also the less accessible sites of ancient cities which have figured so prominently in the history of western civilization, complemented by a luxurious cruise to the beautiful islands of the Aegean Sea. Rarely has such an exciting collection of names and places been assembled in a single itinerary—the classical city of **ATHENS;** the Byzantine and Ottoman splendor of **ISTANBUL;** the citadel of Agamemnon at **MYCENAE;** the ruins of ancient **TROY,** the sanctuary and stadium at **OLYMPIA** where the Olympic Games were first begun, the beginnings of western civilization at **CRETE,** the ruins of **SARDIS** in Lydia where the royal mint of the wealthy Croesus has recently been unearthed; centers of the Ionian League such as **MILETUS** and **PRIENE;** the magnificent marble city of **EPHESUS;** crusader castles at **RHODES** and other sites; beautiful Aegean islands such as **DELOS, MYKONOS, PATMOS** and **HYDRA,** as well as **CORINTH, EPIDAUROS, DELPHI, PERGAMUM, DIDYMA, IZMIR** (Smyrna), the **BOSPORUS** and the **DARDENELLES.** Total cost is **$1299** from **New York.** Departure in April, May, July, August, and September 1970.

EAST AFRICA

21 DAYS $1649

A luxury "safari" to the great national parks and game reserves of Uganda, Kenya and Tanzania. These offer a unique combination of magnificent wildlife and breathtaking natural scenery: great herds of elephants in **QUEEN ELIZABETH PARK,** in the shadow of the fabled "Mountains of the Moon"; a launch trip on the White Nile through hippo and crocodile to the base of the thundering **MURCHISON FALLS;** multitudes of lion and other plains game in the famous **SERENGETI PLAINS** and the **MASAI-MARA RESERVE;** the spectacular concentration of animal life in the **NGORONGORO CRATER;** tree-climbing lions around the shores of **LAKE MANYARA;** and the **AMBOSELI RESERVE,** where all types of big game can be photographed against the towering backdrop of snow-clad Mt. Kilimanjaro. Air travel is used where possible, enabling longer stays within the parks. Also seen are the fascinating capital cities of **KAMPALA, NAIROBI** and **DAR ES SALAAM,** the exotic "spice island" of **ZANZIBAR,** and the historic **MOMBASA,** a beach resort on the Indian Ocean, with its colorful Arab quarter and great 16th century Portuguese fort. Tour dates have been chosen for dry seasons, when game viewing is at its best. The altitude of most areas provides an unusually stimulating climate, with bright days and crisp evenings (frequently around a campfire). Accommodations range from luxury hotels in modern cities to surprisingly comfortable lodges in the national parks (some equipped even with swimming pools). Total cost from **New York** is **$1649.** Departures in July and September, 1970.

Rates include Jet Air, Deluxe Hotels (where available), Meals, Sightseeing, Transfers, Tips and Taxes. Individual brochures on each tour are being prepared.

For Full Details Contact:

ALUMNI FLIGHTS ABROAD
145 East 49th Street
New York, N.Y. 10017

Individuals Noteworthy

Cuthbert C. Hurd, S.M.'59, to President of Computer Usage Co. (Greenwich, Conn.) . . . **Norman P. Blake,** S.M.'56, to Senior Vice-President—Marketing of Pan American World Airways . . . **Parker S. Dunn,** S.M.'31, to Chairman of American Potash and Chemical Corp. . . . **Jerry McAfee,** Sc.D.'40, to President and Chief Executive Officer of Gulf Oil Canada, Ltd. . . . **Herbert S. Potter,** '36, to Vice-President—Domestic and International Relations of Carpenter Technology Corp. (formerly Carpenter Steel Co.), Reading, Penn. . . . **Robert H. Howe,** S.M.'60, to President of the Real Estate and Construction Division of International Business Machines Corp. . . . **David W. Skinner,** '23, to Vice Chairman of the Board and Vice President and **William J. McCune, Jr.,** '37, to Executive Vice-President of Polaroid Corp.

Frank J. Graziano, S.M.'45, to President and Chief Executive Officer of Compton and Knowles Corp., Worcester. . . Major General **John L. Martin,** S.M.'51, to Assistant Deputy Chief of Staff for Systems, Air Force Systems Command . . . **George M. Keller,** '48, to Vice-President of Standard Oil Co. of California . . . **William H. Springer,** S.M.'68, to Vice-President—Marketing, Illinois Bell Telephone Co. . . . **Robert S. Kelso,** '43, to Vice-President—Technical of Cornell Aeronautical Laboratory, Inc.

William K. Hooper, '41, to President and Chief Executive Officer of Republic Foil, Inc., subsidiary of National Steel Corp. . . . **Robert L. Richard, Jr.,** Ph.D.'55, to Director of Manufacture of the Film Department, E. I. du Pont de Nemours and Co. . . . **William R. Armstrong,** Ph.D.'50, to Director of Scientific and Technical Planning, S. C. Johnson and Son, Inc. . . . **H. Reed Gregg,** '63, to Director of Corporate Planning for United Artists Corp.

William C. Kaesche, '44, to Vice President—Manufacturing, Engineering and Purchasing at Velsicol Chemical Corporation . . . **Edmond R. duPont,** S.M.'64, to General Partner, Francis I. duPont & Co. . . . **Byron E. James,** '32, to Chairman and Chief Executive Officer of McQuay, Inc. (Minneapolis) . . . **Peter E. Viemeister,** S.M.'69, to President, Director and Treasurer; **James M. Conners,** S.M.'63, and **Robert A. Nafis,** S.M.'65, to Vice-Presidents—all at Grumman Data Systems Corporation . . . **John K. Jamieson,** '31, to Chairman and Chief Executive Officer of Standard Oil Co. (New Jersey).

Peter B. Baker, '50, to Vice President—Marketing for Norton Company . . . **Walter L. Abel,** S.M.'58, to Vice President of USM Corporation . . . **Wylie S. Robson,** S.M.'56, to Vice President and Assistant General Manager for Marketing Divisions, Eastman Kodak Company . . . **Paul R. Klein,** Ph.D.'59, to Chief Product Engineer—Nuclear Products, Scientific Instruments Division, Beckman Instruments . . . **Edmund S. Rittner,** '39, to Manager of the Physics Laboratory, COMSAT Laboratories.

Randall W. Kirk, S.M.'52, to Vice-President and 747-Coordinator, Pan American World Airways, Inc. . . . **James V. Chabot,** '46, to Chief Engineer of the Ford Motor Co. Design Center . . . **Franklin M. Jarmain,** '53, to Chairman of Genesco, Inc. . . . **Francis Horton,** S.M.'32, to Chief Engineer, Engineering Department, Texaco, Inc. . . . **William A. Krivsky,** '51, to Vice-President of General Cable Corp., in charge of the organization's Research Center and its satellite laboratories.

George M. Berman, '45, to President and Chief Executive Officer of Unitrode Corp., Watertown, Mass. . . . **George E. McKewen,** '45, to Executive Vice-President and General Manager of Champion Pneumatic Machinery Co. (Princeton, Ill.) . . . **John J. Welch, Jr.,** '51, President and Manager of the Missiles and Space Division, LTV Aerospace Corp., to Chief Scientist of the U.S. Air Force . . . **James E. Turner,** '33, to Group Vice-President of Textron, Inc. . . . **Edward B. Colby,** S.M.'57, to General Manufacturing Manager, Detroit Diesel Engine Division, General Motors Corporation.

Francis Horton, S.M.'32, to Chief Engineer of the Engineering Department, Texaco, Inc. . . . **Howard E. Wing, Jr.,** '53, to Director of Product Research, Raytheon Co. . . . **Carroll M. Martenson,** S.M.'54, to Corporate Vice-President, Textron, Inc. . . . Rear Admiral **Thomas S. King,** Jr., U.S.N., '45, to Deputy Commander, Military Sea Transportation Service . . . **Robert B. Newman,** '49, and **Jerome I. Elkind,** '51, to Senior Vice-Presidents of Bolt, Beranek and Newman, Inc. . . . **David W. Skinner,** '23, to Vice-Chairman of the Board and Vice-President of Polaroid Corp.

Rocco A. Petrone, Mech.E.'52, formerly Director of Launch Operations at the John F. Kennedy Space Center, to Director of the Apollo Program, N.A.S.A. . . . **Charles A. Hathaway,** '43, to Executive Vice President of Torin Corporation, formerly the Torrington Manufacturing Company . . . **Charles Kadlec,** '52, to General Manager of Stow Laboratories, Inc.

Warren E. Manger, '43, to Chief Engineer, Astro-Electronics Division, and **Philip A. Piro,** S.M.'64, to Division Vice-President and General Manager, Missile and Surface Radar Division, both at R.C.A. . . . **John I. Hardy,** S.M.'47, to Director of Engineering, Ordnance Division, Honeywell, Inc. . . . **Sanford Sussman,** '51, to Executive Vice-President and Chief Operating Officer of Computer Diode Corp. . . . **Secor D. Browne,** formerly Associate Professor of Air Transportation at M.I.T., to Chairman of the Civil Aeronautics Board. . . . **Robert C. Wood,** Head of the M.I.T. Department of Political Science and Director of the Harvard-M.I.T. Joint Center for Urban Studies, to Chairman of the Massachusetts Bay Transportation Authority.

Robert W. Mann, '50, Professor of Mechanical Engineering at M.I.T., to Chairman of the National Academy of Engineering Subcommittee on Sensory Aids . . . **George S. Schairer,** S.M.'35, elected a corresponding member of International Academy of Astronautics . . . **E. Ralph Rowzee,** '30, to President of the Society of the Chemical Industry for 1969-70 . . . **David P. Shoemaker,** M.I.T. Professor of Chemistry, to Vice President of the American Crystallographic Association. . . . To **Gordon M. Fair,** '16, Abbott and James Lawrence Professor of Engineering, Emeritus, at Harvard University, the Lewis L. Dollinger Pure Environment Award of the Franklin Institute of Pennsylvania . . . To **Robert B. Fleming,** Sc.D.'62, the Russell B. Scott Memorial Award of the Cryogenic Engineering Conference of the National Research Council.

It Fooled Him Not

To the Editor:

When I received the special internationalist-communist issue (June) of *Technology Review,* my initial impulse was simply to ignore the whole thing. But I changed my mind; retrieved the magazine from the wastebasket, in order to verify the expected verbiage, and in order to get the proper address of the editorial office; and decided not to ignore the whole thing, after all. Rather, I decided to let at least the single person who may ever read this letter know that there is one graduate of M.I.T. who is not so easily brainwashed.

I am well aware of the chief purpose of the "cybernetics" of the traitorous internationalist, Norbert Weiner (now deceased)—viz., brainwashing, or thought-control, with its high-sounding, "scientific" terminology. And I am well aware of the visible use of that diabolical "science" in the four principal articles of your special issue.

I am well aware of the intended purpose of the blue-and-white U.N.-colors on the cover and even within the articles—the "cybernetics" of the withdrawal of the red-white-and-blue symbol of freedom, and the in-putting of the blue-and-white symbol of New York communism—the "cybernetics" of the withdrawal of one set of data (symbols, in this case) and the in-putting of a new set of data (symbols) into the human computer-mind.

I am well aware of the intended purpose of the dove-of-"peace" symbol that is so strongly displayed on both the outside and inside of the magazine—the symbol of the "peaceful-coexistence" communist-line, which line was so brazenly used in the very title of this "paper" and in its context, written by a Russian Khazar-communist enemy of our country, and of all true educational institutions, and of all humanity.

In fact, I am well aware of all of the *New York Times'* communist-lines. You might well have left out mentioning this American source of this propaganda-"paper," in order to try to deceive, at least momentarily, a few of those readers who already know what the *New York Times* is!

I am well aware of the red propagandist's hackneyed technique of backing up a lead propaganda-article with "commentary" written by persons of like self-destructive mind—but never printing even one commentary in opposition (not even in his "Letters to the Editor" page). These hypocritical pushers of "free speech" (for communists, only) always manage to leave out any opposition which presents the truth about the total lies of "socialist progress" (starvation!—except for the aid given such dictatorships by the U.S.), "intellectual Freedom" (under thought-controlling communism!), "cooperation" (between slavery and liberty!), "intelligentsia" (communist murderers, "scientific" liars, stripe-panted criminals, and politician-tyrants), "rights of man" (under the slavery of the hierarchy of thought-controllers!), "peace" (under the continual U.S.-aided Russian wars and the U.S.-financed U.N.-wars!), etc., etc., ad nauseum.

I am well aware of what has already happened in a once-great technical institute, when it turns to political brainwashing, when it turns to producing the politics-of-destruction, the politics-of-human-slavery, the politics of its very own enemies within, the politics of its *VERY OWN DESTRUCTION.* Such a status can only mean that its enemies now *CONTROL* that technical institute—from their New York financial and corporation-headquarters, and by means of their lackeys and the ignorant on the campus.

We can see it happening all around us: the universities destroying themselves by the destructive politics that they themselves teach the young, under the lie-word, "education." But, it seems that M.I.T. is too proud to see what is happening in its publications, in its faculty, and to some degree in its students—viz., the promotion of the very same self-destructive politics.

In conclusion, if the Institute were as interested in the promotion of scientific truth as it once was, there would be interest in the available scientific proof that the New York communist-"thing" is all coming to a thermo-nuclear *END* in less than four years. And a truly scientific institution would be seeking out and making known to others this kind of scientifically provable truth, to the saving of human lives, rather than promoting propaganda-lies.

Yes, your June issue, sent to all alumni, whether subscribers or not, had, by that very fact, a most obvious purpose.

But, it fooled me not.

J. Douglas Brawner, III
SM XII, 1943
2611 W. Golf Course Road
Midland, Texas

Harrassment of R.O.T.C.

To the Editor:

I am delighted to learn that M.I.T. still provides a Naval R.O.T.C. program (Technology Review *for June, page 84*). Quite obviously the Navy needs officers who had the educational advantages provided by M.I.T.'s curricula.

At the 13th annual reunion of the Early and Pioneer Naval Aviator's Association in June at the Naval Air Training Center, Patuxent River, Md., the "downgrading" of the R.O.T.C. programs at various universities and colleges was discussed at some length. On July 14, R. L. Ireland, who was elected Pilot (President) for the coming year, wrote to the Honorable John H. Chafee, Secretary of the Navy, as follows:

"All members present expressed the view that as individuals we should express to our respective alma maters our strong opposition to the down-grading of Naval R.O.T.C. Our members have instructed me to inform you that they, as individuals, intend to protest and bring pressure, if they can, upon the colleges that are making decisions to withhold academic credits, exclude staffs from faculty status, or even abolish their Naval R.O.T.C.

"It is the unanimous feeling of our members that such harassment of R.O.T.C. is contrary to the national interest and gives aid and comfort to those who wish to disrupt and destroy our country."

Richard T. Whitney, '17
Redart, Va.

Class Review

Copy for this issue of *Technology Review* was due from your Class Secretary about October 15. News reaching him after that date will appear in a subsequent issue.

95

It is difficult for me to realize that I became 96 years of age last October. However, when I read the citation presented to me with the Bronze Beaver Award, for 75 years of service, I would have to be almost 100 years old. I could hardly believe this great honor came to me but my family certainly appreciates it and reminds me of it with real pride in this "old man."

I telephoned the nursing home where **Luther Conant** is and, through a nurse, learned he is doing well "for his age." He does not get out but his son visits him. Norwalk, Conn., is a little too far for me to pay him a visit which I regret.—**Andrew D. Fuller,** Secretary, 1284 Beacon St., Brookline, Mass. 02146

98

Hello from afar. The winter trip with our Airstream trailer has taken us to the southwestern states, an area we have not explored before. We are really enjoying retirement; I retired, too, from community service and church work in Springfield. Harold says he doesn't miss teaching—too busy travelling. We drove into Mexico on November 29 to Saltillo, Coahui'a then to Guadalajara, a large city with spring-like climate. Harold found Patzcuaro especially attractive for picture taking. Some of the buildings date back to the 1500s; the lake is where the fishermen use the butterfly-shaped nets. Other delightful places were Morelia, Puebla, Cuernavaca and Mexico City where we welcomed the New Year.

In Oaxaca we observed Christmas in accordance with our customs as well as those of our Mexican friends. At the Fiesta of the Virgin of Soledad, giant figures led processions from church to plaza where the people ate "bunuelo" (cake) from bowls which they shattered on the pavement for luck. Of course there were the traditional piñatas, filled with sweets, nuts and fruit. At Xochimilco we saw the beautiful floating gardens. Archeological sites were interesting, especially Teotihuacan on the outskirts of Mexico City. On our way back to Texas we stopped at Queretaro, Matahuala and Monterrey. If all goes well, we will not go home until the first of May. Please write to me because our mail is forwarded to General Delivery as per our periodic instruction to the Springfield mailman.—Mrs. **Audrey Jones Jones,** Acting Secretary, 232 Fountain St., Springfield, Mass. 01108

00

Alert **Charles E. Smith** writes from New Haven, Conn.: "Here is an item for the Class of 1900 that appeared in the *Boston Herald* November 25, 1969. Coming events cast their shadows before. . . . It is the brain child of our classmate **Chas. A. Newhall.** . . . " Mr. Smith goes on to comment that he knows of no more appropriate place for such a development than Harvard Square, both from a business and traffic viewpoint. "Increased traffic congestion alone makes such improvements inevitable."

The *Herald* reported that architects and Harvard Square property owners want to build a roof-top second-story pedestrian boardwalk above the present Harvard Square to include "the elegant and the novel, enchanting boutiques and sidewalk cafes." This would require the renovation but not the demolition or relocation of any existing buildings—development depends on the voluntary cooperation of the property owners.

". . . the plan was presented formally to 25 persons, including about 13 Harvard Square property owners at a luncheon held at the 1200 Beacon St. Hotel by Charles A. Newhall. . . . Newhall, a 93-year-old Brookline real estate magnate, commissioned The Architects Collaborative (TAC) a year ago to do a feasibility study on a second story walkway above the College House, property he owns on the corner of Church Street and Massachusetts Avenue in Harvard Square. . . . Newhall also has suggested a similar second-story sidewalk network for the Tremont street shopping area in Boston. . . . The Cambridge project grew, with Newhall's and the architects's imagination, to include the two-block area bounded by Massachusetts Avenue, Church Street, Palmer Street and Brattle Street. It spreads across Brattle street to the Brattle Theater and the Cambridge Adult Education Center. . . . Newhall commented, 'I'd just like to make that square useful. It isn't useful today.' "—*Technology Review,* Room E19-430, M.I.T., Cambridge, Mass. 02139

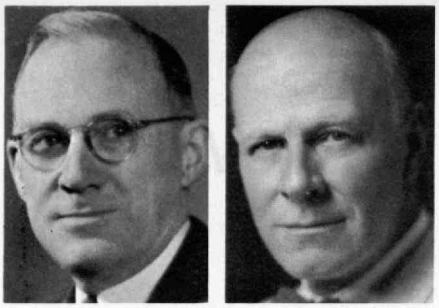
03

Well, classmates, we are again thrilled by an interesting autobiography. This one is from our busy and highly successful chemist classmate, **Robert J. King,** Course III, at his factory on Science Road in Norwalk, Conn. Robert was born in Nashua, N.H., November 29, 1881, the third son of William Hubert and Amanda Grenholm King. When he was three years old his parents moved to Billerica, Mass., where he received his early education in the local public schools. He passed the rigid entrance examination at M.I.T. and enrolled with our Class.

During Robert's college years his activities included the Dramatic Club and the Y.M.C.A.; he took an active part in the 1902 Tech Show. After graduation he was employed by the Merrimac Chemical Company in North Woburn, Mass. He left there to work in the research laboratory of Thomas A. Edison in Orange, N. J. His contact with this genius stimulated his desire for further research and in 1918 he started his own chemical factory in Stamford, Conn.

His success in the invention and manufacture of plasticizers for use in the enormous rubber market soon necessitated larger accommodations. About 1929 he built a second factory in Norwalk, Conn., known as Robert J. King Co., Inc. In time his business expanded to embrace three corporations, Robert J. King Co. Inc., King Organic Chemicals Inc. and King Industries Inc. In 1961 the three corporations merged into one—King Industries Inc., which now manufactures rubber plasticizers and rust inhibitors which are sold all over the world.

In 1956 Robert was honored with a D.Sc. from Piedmont College in Demorest, Ga., to which he donated the large, modern King Science Building, the only fully air conditioned and electrically



Paul W. Norton, '08 *H. D. Chandler, '08*

heated science building in the state. He is now chairman of the Board of Trustees at Piedmont and attends most of the Board meetings.

Robert is president of King Industries but still finds time for local civic affairs, the Presbyterian church and the Y.M.C.A.

Mrs. King, the former Lavinia Knox, is treasurer of King Industries and Robert's enduring companion in both business, and family life.

Your Secretary has sent a most sympathetic letter to Mrs. Mary Claire Geary, the daughter of our distinguished and ever loyal classmate **John J. Dooley,** Course VI, who died suddenly November 30, 1968. My last letter from John was sent from his son's home in San Mateo, Calif. He was visiting his son to try and overcome grief caused by the death of his wife who had been his long-time and affectionate companion.

George E. Kershaw, Course XIII, has a new address, 182 Oaks Road, Millington, N.J. 07946.—**John J. A. Nolan,** Secretary/Treasurer, 13 Linden Ave., Somerville, Mass. 02143

05

September seems to have been old home week at least as regards '05 men seeking our official headquarters at Hobby Knob, Center Sandwich, N.H. First the **Bill Spauldings** coming from Bill's brother's home in Fryeburg, Maine, paid us a visit during which we did a lot of reminiscing in regards to our days at the Tech on Boylston St. Both he and Alice looked "right smart," and said they felt as well as they looked.

Next, Isabel and **Charlie Smart** drove in after a tour through northern Vermont and the hob-nobbing at Hobby Knob began again. Charlie has been retired from the Gurley Company, the company having been absorbed into one of the national combos. Both seemed well, although admitting occasional breakdowns, which is about the same as my term, considering.

Then came the Dean **Klahr**s chauffered by son Paul who had come across the country to take the New England trip with them. Lots of misfortunes happened to "C.D." and Helen since we had last heard from them. C.D. had had two operations; recuperations were long but he apparently survived them well as he appeared in good shape despite the loss of considerable weight. He has gone back to work as a "county viewer." Progress, it seems, has been taking its toll around Erie. When the State or Federal government takes over a property and awards its estimate to the owner, he has a right of appeal to the "viewers" who make their inspections and correct the error, if any. It gives Dean something to do to keep him out of mischief. Mischief? Well, Charlie Cross thought so. Helen has never fully recovered from her accident, the smashing pretty generally of her ankle.

Well the autumn foliage and the Sandwich Fair are over. Those who missed will a have to visit headquarters next year or anytime in the interim.

Herb Bailey, Course V, our very good correspondent from Ontario, Calif., in answer to congratulations on his 89th birthday writes: "This summer our family has been well scattered with only daughter Lucy and I at home. But we did have two of our son Edgar's children with us part of the time living here while working my old Sunkist Orange plant. Their dad was back in Turkey with his CENTO sponsored school for the geologists of Turkey, Pakistan and Iran. His wife and their two youngest went as far as Europe with him and then toured Germany etc., until he joined them in Greece. My grandson, Steven Moore went to Germany right after he finished his sophomore year at Pomona to study languages. His dad joined him after doing England and they had a week in Italy with daughter Laura, whose husband, Larry, finished his 2 years in the army in Germany in February and they have been sight seeing since." Herb gives us lots of news and I am sure those who knew him well at M.I.T. have engoyed it.

Another obituary. **Leslie Clough,** Course II, 88 years of age of Weymouth died September 21 at Weymouth, Mass. He was a heating and ventilating engineer with Bradlee and Chatman of Boston for many years. I remember commuting with him on the old South Reading branch (now extinct) of the B&M R.R. many times.

Quite a number of times as I have read the *Review* I have noted articles by Professor Edward N. Lorenz, MT'43, Professor of Meteorology at M.I.T., and I have wondered whether he might be the son of our Edward H. Lorenz. I now learn that he is. Remember when our Ed won many long distance runs for M.I.T.?

Change of address—**Gilman B. Joslin,** West Roxbury Manor, 5060 Washington St., West Roxbury, Mass. 02132. I don't know the reason but hope to learn.—**Fred W. Goldthwait,** Secretary, Box 32, Center Sandwich, N.H. 03227; **William G. Ball,** Assistant Secretary, 6311 Fordham Place, Bayshore Gardens, Bradenton, Fla. 33505

06

It is gratifying to have no classmate's death to report but I personally have lost a longtime dear friend, and so has the Institute. Treasurer Emeritus, Horace S. Ford died September 23 at 100 Memorial Drive—his home for many years. Horace and I were classmates in Gloucester High School, and after a few years with the Old Colony Trust Co., he became Bursar of M.I.T. in 1914, Treasurer in 1934. During the years I was at Tech Horace roomed with me, first on Dartmouth St. and then on St. James Ave. As the details of Horace's productive career and his many affiliations will appear elsewhere in this ussue—or have previously—I will only add that a note of sympathy has been sent to the widow and to his two sons.

We had a note in September from my good correspondent **Jim Wick, Jr.** who said he was still "tottery" and busy with historical affairs, as he is president and treasurer of The Mahoning Valley Historical Society, which held its 94th annual meeting September 10 in the Arms Museum on Wick Ave. in Youngstown, Ohio. In 1875 on that date it was Hugh B. Wick who was Chairman of "The reunion of the Pioneers of Mahoning and

Trumbull Counties, Ohio," and in 1909 Jim Wick, Jr., was on the committee which formulated the Articles of Incorporation of that historical society. The Wick family has had much to do thru the years with Youngstown cultural, educational, and civic affairs.—**Edward B. Rowe,** Secretary-Treasurer, 11 Cushing Rd., Wellesley Hills, Mass. 02181

08

We regret to report the death of **Paul W. Norton** on September 5, 1969 in Wellesley, Mass. He was born in Amboy, Ill. in 1883 and graduated from Amherst College in 1905 before graduating from M.I.T. as an architect. Mr. Norton was chief engineer for the Boston firm of Maginnis & Walsh from 1913 to 1940 when he became a partner in the founding of Nichols & Norton. As consultant in the firm of Nichols, Norton and Zaldastani, incorporated in 1964 for the practice of professional engineering applied to structural design, Mr. Norton was responsible for the structural design of many projects, including the National Shrine of the Immaculate Conception in Washington, D. C., the Cathedral of the Assumption of the Blessed Virgin Mary in Baltimore, and buildings at Boston College, Notre Dame, Harvard University and M.I.T.

He was a member of the Faculty of M.I.T. from 1917 to 1935 and a special lecturer at Harvard University Graduate School of Design from 1936 to 1939.

He had been a life member of the American Society of Architects, a member of committee number 315 on Detailing Concrete Structures since 1953, a member of the Boston Foundations Code Committee from 1957 to 1962, of the American Society for Testing and Materials since 1961 and of the Colum Research Council of Engineering Foundations since 1949; in addition he was a Registered Professional Engineer in Massachusetts, New York, New Jersey, Missouri, Maryland, and the District of Columbia. Surviving are his widow, a daughter, Joan, and a sister Mrs. Frank Kressen of San Clemente, Calif.

We are a little late in reporting the death of another Boston architect, who died soon after we lost our secretary Mr. Carter. Mr. **H. Daland Chandler** of 50 Commonwealth Ave., a noted architect and member of the Boston Planning Board died January 11, 1969, at the age of 84. He was a native of Boston, attended the Groton School and was graduated from Harvard in 1906. He was also a graduate student in architecture from M.I.T. and at the Sorbonne in Paris.

During World War I he served in the Coast Artilary as an aide-de-camp to Major General C. R. Richards. Chandler later was associated with the architectural firm of Peabody and Stearns, Allen and Collens. In addition he was a member of the planning and technical division of the Massachusetts Committee on off-street parking of the Mayor's Conference on Traffic. He leaves two sisters, Mrs. Herbert E. Winlock of North Haven, Maine and Mrs. Edward F. W. Bartol of Lancaster, Mass., a nephew Francis W. Bartol of Wayland, Mass. and a niece Mrs. David Lannon of New York City.—**Joseph W. Wattles,** Acting Secretary, 1507 Casey Key Rd., Nakomis, Fla. 33555

11

Last month in these notes there was a story about **Edwin Pugsley**'s hobbies. This month we have his own interesting account of his life. "I did not plan to come to M.I.T. until the end of my junior year at Yale when I suddenly decided to try Course VI and shaped my senior year as well as possible at that late date to help me in my new venture. I also found out that a course or two in summer school would probably shorten the time necessary to get through Tech.

"Accordingly, after a wonderful graduation week at Yale I came to hot Boston and sought out Professor D. C. Jackson, head of Course VI. His office was a hot cubbyhole in the old saw tooth building in the Back Bay section and as his door was open and he was writing at his desk, I ventured in. He continued writing, paying no more attention to me than to one of the numerous files against the wall. I stood first on one foot and then on the other for what seemed an interminable time but he still kept on writing. Finally, without looking up, he said 'Well, what do you want? I told him with all the seeming modesty I could muster that I had just graduated from Yale and wished to enter Course VI. Still writing and without looking up, he said, 'We've had one Yale man in Course VI but he didn't graduate.' That apparently ended the interview and I assumed that I was now a member of the student body of M.I.T. That was all the formality required and even though I had thoughtfully brought my Yale diploma it was never asked for.

"The transition was terrible and I had great difficulty adjusting, but gradually I learned how to study and after the first year began to think that I possibly could make it. To digress a moment, Professor Jackson gave a course in the senior year that had to do with problems arising in what were then considered high tension power lines and he gave out a problem that would take two or three weeks to solve. About the second week he called on me for an answer as far as I had gotton. With considerable doubt I gave him what I had worked out. The Naval constructors from Annapolis were required to take the course and he asked one of them to check my result. This Naval superman (from my standpoint) said he had approached the problem from an entirely new angle and could not check my figures. I left the class marveling at anyone working out a new approach. Some seven or eight years later I had become chief engineer of Winchester Repeating Arms Company and we had hired several of these Naval Academy graduates. At a social function I met one of these Naval men and told him the story. He, astonishingly, told me that he had been the man Jackson had called on to check my figures. He had attended the G. E. Apprentice School the previous summer and had a group of curves that gave the answer to the problem. He was scared stiff that Jackson would find this out, as all he had to do was read the final answer from the curves and he had done no work on the problem. Small world! "But to continue, I found that I could complete all of my required courses during the first term of my last year except a measly little course in hydraulics. Accordingly, I appealed to, I believe, Professor Porter, head of the hydraulics course, for permission to tutor in the course and take the exam at midyear, as I did not want to come back for the one course. He turned me down flat and refused to consider giving me an exam at midyear. I then went to Professor Jackson with my problem, telling him that I had a job and a girl waiting for me and I would consider giving up my degree rather than come back. Professor Jackson had in the bottom drawer of his desk a set of cards for each man in the course, and took mine out. After studying it he said 'You had a little trouble when you entered.' I told him that was a gross understatement as I had nothing but trouble. However, he continued that I seemed to get things rolling later, and that I should plan to take the hydraulics exam at midyear. I heard later that he had a real battle with Professor Porter but won out. I took the hydraulics exam at midyear, passing it with the others, and was granted my diploma in absentia the following June.

"After a short break on the family plantation in northwest Florida, I entered the Apprentice Course at Winchester Repeating Arms Company the first week in March and the following November married Dorothy Silliman Wright, daughter of Professor Arthur W. Wright who for the last 20 years had headed the Academic Physics Department at Yale and who was the first man to experiment with Roentgen Rays in this country. A few years ago the new Yale Nuclear Laboratory was dedicated in his name.

"By the time the United States entered World War I, I was Chief Engineer of the Winchester plant and our first engineering job for the government was the transformation of the British .303 Pattern 14 Enfield rifle, for which we had large contracts and were currently producing, to handle the U.S. .30-06 cartridge. Quite a controversy had developed in Washington as the military naturally wanted the .30-06 Springfield instead of the transformed British rifle. However there were three plants, of which we were one, producing 10,000 British rifles a day and the change over to the American cartridge was a matter of weeks whereas to change to the entirely new U.S. rifle would have taken months and time was of the essence.

"The Ordnance Department made the only decision they could under the cir-

cumstances and I was ordered to make the change as soon as possible. This started an around-the-clock job and we were the first to complete the change. Our gun was finished about 10 a.m. on a Saturday morning and I grabbed it and the company Cadillac and by going 60 miles an hour most of the way (fast for 1917 roads and car) arrived at Springfield Armory just as the noon whistle blew. The guards refused to let me in but I happened to know the commanding officer so asked to be allowed to call on him. This was granted and I went up his front steps two at a time, rifle in hand. He answered the door himself and I told him of the rush of night and Sunday work that had gone into the production of the gun. He floored me, however, by saying he believed it would be a long war, the help needed a rest and the boilers needed cleaning; consequently he had closed the Armory for two weeks and would begin testing the rifle two weeks hence. (At the time our recruits were drilling with broom sticks for want of rifles.) He did, however, consent to let me leave the rifle with him. I got on the telephone as soon as possible and reported the situation to President Otterson of Winchester. He, in turn, got Washington on the phone and the testing of the rifle started that afternoon.

"Just as we were catching our breath from getting the Springfield Model 17 (the name given to the transformed Enfield) going, the president called me into his office and told me he had taken an order for 50,000 of the new Light Browning Machine Rifle, and to get busy on its production. The B.A.R. (Browning Automatic Rifle) as it was called, was a totally new concept and Colt and Marlin had already begun to tool up for it. However, I found there were no model drawings and only one sample gun which had been fired better than 50,000 rounds, and further that Colt would only release the sample on Saturday afternoon and Sunday.

"I personally got the sample the next Saturday noon and had the Engineering Department waiting for it. We put every man we could crowd onto the sample and by about the third Sunday had quite a lot of data in process. President Otterman, a Naval constructor and M.S. from M.I.T. in 1909, had done an excellent job in shaping up the Winchester organization and it began to function smoothly. It had taken the original organization just a year to tool up for the Enfield but we produced the first B.A.R. in three months and five days. It is my recollection that when the war ended there had been 49,000 B.A.R.'s accepted by the government, of which W.R.A. had made 47,000.

"Just as we were beginning to get our heads above water on the B.A.R. job Otterson again called me into his office on a return from Washington and said that the Ordnance Department was short of Colt automatic pistols and ammunition and also wanted to increase our production of rifle ammunition, and he accepted and order for 50,000 pistols and several million rounds of both .45 A.C.P. and .30-06 ammunition. I asked him where he thought we could fit this new commitment in and he said he believed we could spread the work through New Haven—Winchester to assemble and test both the pistols and the ammunition. I canvassed the leading plants in the city and was surprised at their eagerness to cooperate. The new idea of rationing had been started and some of the plants without Government orders were finding it increasingly hard to get such rationed items as coal, fuel oil, steel, etc. It was Winchester's job to provide the machines, tools, gages and know-how. I happened to know where there was a small cache of gun making machines and a small idle cartridge plant. The government requisitioned all of this equipment and, had the war lasted another month, we would have been producing pistols and ammunition by these community efforts. (When the war ended it was a job to get the omelet unscrambled and the eggs back in their respective shells.)

"Sometime in the middle of the summer of 1918 Colonel McFarland, then head of the Ordnance Experimental Department, walked into my office unannounced, swore me to secrecy and told me that Quentin Roosevelt had developed the tactic of riding right into an enemy plane with all .30 caliber machine guns blazing, and had some seven or eight enemy planes to his credit. On this particular morning he had tried this tactic but his bullets bounced off the enemy plane like peas off a hot griddle. The Germans had sprung an armored plane on us and Roosevelt was shot out of the air. General Pershing had cabled the Ordnance Department for a gun light enough for the 1918 planes to carry and strong enough to pierce any armor that planes might carry. Roosevelt's death had been held from the press and Colonel McFarland had not had time enough to work out any ballistics other than that the Ordnance Department thought the gun should be at least .50 Caliber.

"We pantagraphed the .30-06 round to .05 cal. and made up a few cartridges which looked all right to the Ordnance Department, and also a test barrel. The colonel took some dummy rounds up to Colt where Browning was working on the gun. Results of that firing showed that there was not sufficient powder capacity in the case as first designed and that it would be necessary to lengthen it about one-fourth inch. I phoned Colonel McFarland who came up from Washington immediately. We checked our figures and agreed to the change, taking some of the new length dummies up to Mr. Browning.

"We were satisfied that the gun would be ready to test by Labor Day so President Otterman and I, with 100 rounds of ammunition, drove up to Colt. The trail was held on the old Hartford Airport, which was about where the new Connecticut River Bridge is. Present were General Williams, Chief of Ordnance, Colonel McFarland, Mr. Stone, president of Colt and their chief engineer, Mr. Otterman, president of Winchester, Mr. Browning, a scattering of colonels and myself. Mr. Browning put ten rounds in the belt, fed it into the machine gun and pulled the trigger. The round fired but the gun jammed. About the only measuring device I ever saw Mr. Browning use was a dilapidated old folding carpenter's 2 ft. rule. He used this to measure the length of the round and announced that Pugsley had made a mistake and had made the round one-half inch too long. Colonel McFarland stepped right up to my defence and reminded Mr. Browning that he had notified him when the change was made and had brought him the new dummy cartridges. Mr. Browning thought possibly the dummies had gotten mixed.

"Meanwhile President Otterson had gotten General Williams aside and pointed out the difficulty of making the gun in one place and the ammunition in another, recommending that the whole job be turned over to Pugsley as he didn't have much to do! General Williams consented, and the gun, General Williams and as many of the others as could crowd into the old company Packard came back to New Haven, and another round-the-clock race with time was started.

"The gun Colt had made was a water cooled ground gun and the gun Ordnance wanted was an air cooled airplane gun. As a consequence we had to completely redesign the gun, which we proceeded to do using all the mechanical equipment and mechanics available in the New Haven area.

"The Ordnance Department had been under heavy criticism from Congress due to its failure to produce munitions on time, and they had begun a series of shows at Aberdeen Proving Ground to which the Congressional Military Affairs Committee and other influential members of Congress had been invited. There had been one or two such demonstrations and another was scheduled for November 11, 1918. It became apparent that the war would end before this date but, since the show was all planned, it was decided to go ahead and hold it on November 18, a week after the armistice. We worked feverishly to meet this date and by the afternoon of the 17th the gun was about ready. Mr. Browning came down in the afternoon to watch it being assembled and by ten that night it was ready but had never been fired. The last train left at midnight and it was decided to take a chance. Mr. Browning fired it successfully the next day before about all the Army brass in the country, and the gun was turned over to the Ordnance Department. This was the first firing of the .50 cal. machine gun.

"The end of the war posed many problems. Winchester was faced with a greatly expanded plant and it was obvious that products other than sporting arms, and ammunition would be needed to absorb its capacity. There followed an experimental period of trying in the hardware trade to copy the Rexall scheme

that had been so successful in the drug trade. Winchester branched out with agency dealerships and later with company-owned stores. It was decided to enter the manufacture of many items sold through the hardware trade and I was ordered to get the company into the production of, among other things, pocket and kitchen cutlery, flashlights and batteries including the budding radio lines, roller and ice skates, axes and a full line of carpenter's tools, steel and bamboo fishing rods, bait and reels, and later a gas fired refrigerator, washing machine, as well as routine development of sporting guns and ammunition.

"This was a large order and too much for the financial strength of the company. As a result in 1924 there was a reorganization, and I became factory manager. However the company's wounds were too deep and with the coming of the depression had to go into receivership. The Olin interests courageously bought the plant out of receivership, and following the reorganization I became vice president of the Winchester Branch of Olin Industries. Many changes were instituted and under the strong management of Olin the plant began to prosper again. The Winchester Repeating Arms branch was finally consolidated into Olin Industries and I became an officer and director of Olin Industries. As the war clouds gathered I spent more and more time in Washington and handled all contracts for the Winchester division with our own government and foreign governments.

"With the establishment of the Winchester division the company wanted to start a research and development department at New Haven, which I organized and headed. At the beginning of World War II we were asked to develop a light cartridge for the light carbine which the Ordnance Department was considering. This we did, but did not submit a gun for the first test. However, we had some ideas for a light carbine and the Government insisted that we enter a gun in the second test. We agreed to make a gun and produced our sample in a little over nine days. The Ordnance Department liked the general design and we put the gun in the second test that was unanimously adopted by the Test Board and became the U.S. .30 cal. Carbine M-1, of which many thousand were made by some five facilities.

"I retired on pension after 40 years' service but remained with the company on a consulting basis. They sent me to Europe three times and on the first visit I was asked to chair an international N.A.T.O. Task Force charged with finding out where all the munitions of war could be raised for the N.A.T.O. troops which it was proposed General Eisenhower command. On another company assignment I was sent to Japan and my wife and I continued around the world as the shortest way home. Since retirement I have been so busy with a number of hobbies that I don't see how I ever had time for a full time job in the plant."

Two address changes have come to my notice. **Minot Dennett,** Apt. 307, Lucerne Towers, 20 West Lucerne Circle, Orlando, Fla. 32801; and **Lloyd C. Cooley,** 3257 Pinecrest St., Sarasota, Fla. 33580.—**Oberlin S. Clark,** Secretary, 50 Leonard Rd., North Weymouth, Mass. 02191

12

DO YOU REMEMBER THE "college ice" that some of us purchased almost daily at the drug store as a special gustatory treat? George Sprowls says he found it appealing but no different than today's ice cream sundae. He was soon introduced to "hot chocolate fudge marshmellow college ice" at Bailey's on West St. and found it so good that, in later years, whenever in Boston he never missed having at least one of these wonderful concoctions.

George Sprowls, Course VI, writes that he joined our Class as a junior in the fall of 1910, having received a B.A. and an M.A., and an honorary D.Sc. from Washington and Jefferson College. Tech was tough going, however, and he would never recommend this procedure to others. In 1912, he had decided to go with Bell Telephone Laboratories on graduation but, through Dr. Lawrence, became interested in an offer from Goodyear Tire and Rubber Co. of Akron, Ohio, and accepted a position in the development and design department. At that time, there was a question whether the electric or gasoline truck would prevail. The distance the electric truck could operate on one battery charge depended somewhat on the efficiency of the tires, and they wanted an electrical engineer to make tests in order to increase tire efficiency. He continued to advance in the organization, and remained with them until compulsory retirement in 1957 after 45 years of service. During this period he spent about one and one-half years in England, Scotland, Europe and North Africa, surveying tire conditions. His activities also included practically all parts of the United States, including Hawaii. As head of the Highway Transportation Department, he supervised this work throughout the country.

George was married in 1936 to Margaret Crawford of New York City in the New York Cathedral of St. John the Divine, and they have enjoyed many happy years together. He served in both World Wars. Prior to the first war he was living in New York and went to Washington in the engineering division of the Ordnance Department, where he became Major. In World War II, he was in charge of the Navy Rubber Survey, and later acted as chief consultant on rubber for the Office of Defense Transportation. When retirement arrived, George was not prepared for the change, despite his several hobbies, which included photography, bowling, golf, music and theatre. Therefore, he was most pleased to accept an offer from Tyrex, Inc., Akron, as Director of Research and opened an office for them. This activity also required traveling, which averaged 125,000 miles per year. He enjoyed this work for ten years and retired permanently in 1967. Since then he has been engaged in various activities. He is a member of the Local and National Affairs Club and the World Affairs Club, as well as the Thursday Morning Discussion Club, and also regularly attends the University of Akron "University Cultural Series." He is also interested in music and regularly attends the Cleveland Orchestra Concerts and others of high quality. He is also a member of the local amateur playhouse. George concludes, "Summing up everything, I feel that I have had a most interesting and happy life. I have attended several reunions of our Class and remember well the excellent meals at Snow Inn. I expect to attend the next reunion and at that time hope to renew acquaintances with many of the Class of 1912."

Willis Salisbury has prepared the promised condensation of the 44-page story of his 25,000-mile trip to Africa from January to April, 1969, and here it is. "As expected, most of the population is black and civilized, and is quickly taking over the reins of government in the many newly formed republics. But I was not prepared to see the beautiful, large modern cities which we met from the start of the trip. Flying directly to Dakar, capitol of French Senegal on the west coast, we found a city of 400,000. Both men and women wore long robes of brightest colored fabrics, many men wearing fezzes, since they are about half Moslems. There is a modern civic center and a President's palace. Our hotel faced the beach, ten miles from the city. We then flew to Bamako, capital of Mali, on the Niger River, another lovely city. A thousand mile hop took us to Timbuctoo on the western edge of the Sahara, one of the oldest cities in Africa, small and rather primitive. The buildings were all of hand-made bricks and the streets were unpaved, transportation by camels, donkeys and burros. Meals were good but rooms bare, though comfortable and no hot water.

"Then back to Mali and to Abidjan, Ivory Coast city of 300,000—well laid out with fine boulevards. Our 30-story hotel served good French meals with music. There was a fine new university. Through the countryside, we found the roads crowded with people. The women had huge loads on their heads, as well as babies on their backs. The men walked ahead, carrying long spears and staves as protection against wild animals. Much of the land was under cultivation—palm oil, coconuts, coffee, cocoa and an orchid farm. Our next stop was at Accra, Ghana with a population of 1,200,000. There were crowded markets in all these cities, often covering several blocks, and selling everything. There were practically no whites.

"Johannesburg (1,250,000) is a busy metropolis, where gold is king. It is surrounded by huge piles of yellow sand, the tailings from the mines. We attended the regular tribal dances with competi-

Bartow V. Reeves, '12 (left), and Ray Wilson, '12, at Peddler's Village, Lahaska, Pa., after lunching with their wives at the old Cross Keys Inn.

tion between tribes, held in a special small stadium; most colorful. We drove to Pretoria, South Africa, where a short flight took us to Kimberly and the De Beers diamond mine. One shaft is 1,700 feet deep. The diamond carrying lava is crushed and fed onto a wide belt, coated with grease, which holds the diamonds as the residue is washed off the belt. We took a train to Capetown (500,000), founded in 1666, and a bus to nearby Table Mountain, with a cable lift up to a fine view of the city and harbor. Then a beautiful 100-mile drive to the Cape of Good Hope and return with gorgeous scenery—beaches and mountains everywhere. We next enjoyed a five day, 1000-mile tour along the Garden Route, up the east coast along the Indian Ocean to Durban. Tea every day at ten a.m. The route was indeed well named, with mountains, forests, farms, orchards, towns and villages along the way. A big valley with many ostrich farms intrigued us, and we visited one where we learned the life story of these birds from the egg to the market.

"We lunched one day at Port Elizabeth (400,000) founded in 1497, and at Umtata was a tribal dance by eight girls, 14 to 17, daughters of a chief and his six wives, who gave us the original grass skirt, topless version. Next evening, we were shown a movie of the circumcision rites of the boys, which do not occur until they have killed a lion with spear and stave, at 17 to 20 years. The boys are painted white, housed in a mud hut for three months, after which they are washed and repainted red. The operation is performed with a long butcher knife, and the wound covered with a carved-out bulb, which seems to cauterize it. Any candidates? Durban is a gorgeous "little Miami" of 700,000, with a big harbor lined with modern hotels. From my window I could see the beautiful beach just 200 feet from the front door, also two swimming pools just inside the breakers.

"I had a note of introduction to the manager of the magnificent Barkley's Bank, who invited me to his home for dinner—a rare treat, as there were other interesting guests.

"We next stopped at Lourenco Marques (Portuguese) in Mozambique, lovely city of outstanding architecture. We then drove to a rest camp in Kruger Park where we spent the afternoon and the next morning in special Rambler cars, driving about the area, and saw baboons, wart hogs, giraffe, impala by the hundreds, waterbuck, bushbuck, buffalo, hippos in the mud and water, many kinds of birds, and a herd of elephant along the road. Then a night's run to Pretoria and a morning flight to Windhoek, capital of South West Africa. Next morning we drove to Swakopmund, seeing much wild life on the way, ostriches, sand hens, weaver birds, springbok, steinbok (only two feet high), hooded vultures and karakul sheep. This small town had a most modern hotel and excellent food. Our next stop was Bulawayo, Rhodesia, where we visited the grave of Cecil Rhodes.

"We then flew to Victoria Falls, a beautiful sight, one and one-half miles wide and 360 feet high. The hotel supplied us with raincoats and boots for a walk through the rain forest along the bank of a narrow canyon into which the river drops, the spray from the falls producing heavy rain. Afterwards, I chartered a small plane and with another couple, had a wonderful flight over the falls. Next day we flew to Salisbury, a remarkably clean city, and younger than I am. I had an introduction here to an elderly widow and her son, who own a large coffee and sisal estate. They drove me out to their lovely home for a day's visit, and I saw the harvesting and processing of both crops, a thrilling experience. We flew next day to Dar es Salaam, Tanzania (180,000) in a Moslem country, an interesting change of pace; a fine university here.

"A short flight took us to Zanzibar, where the doors on many buildings are studded with heavy bronze spikes to discourage elephants. The city is almost wholly black and most natives are very poorly dressed. Then to Mombasa, Kenya (400,000) with lots of manufacturing. We flew to Lake Manyara, Tanzania, and took buses for a drive through rural farming country of coffee, corn, pineapple, wheat and bananas. Our hotel was on a 1,400 foot cliff overlooking the lake. Looking down, I could see many wild animals. Nearby storks rested in trees and beautiful crested cranes stalked about.

"Our next move was to Ngorongoro Crater Park, where we drove down 8,000 feet inside the crater and found a gorgeous lodge and cottages. Early next morning we started out in Land Rovers, down 2,500 feet to the crater floor, where we saw many kinds of animals and birds. A pair of lions were lying side by side in deep grass. One lion arose and walked around his mate, gently nibbling at her face. He opened his big jaws and bit her on the nose. At noon we had a box lunch in a grove and were entertained by some little black monkeys with white faces. Then a few Masai warriors, the tall ones with spears, and hair braided in thick red mud, came to call, and allowed us to photograph them, but charged a goodly fee.

"For the next two weeks we visited some seven more game parks all different and exciting, and with thrilling scenery, which included almost a day's drive in sight of Mt. Kilimanjaro, a night at Treetops Hotel, a launch ride on the Nile with hundreds of hippos in the water, also huge crocodiles and many varieties of birds. We then flew north to Addis Ababa, Ethiopia, where I visited Hailie Selassi's stables, housing 21 fine horses. The groom who met me at the gate took me to see the emperor's special riding horse. In the afternoon, our group was invited for tea by U.S. Ambassador Hall and his wife, a very pleasant "Good Bye" to our 10 weeks in Africa.

But my trip was not yet over. It was still 18 days before I arrived home, as I flew then to visit friends of previous journeys, and to do a bit of sightseeing in Athens, Salzburg, Belgium, Amsterdam, London and Edinburgh. However, that is another story. Long ago you have become too tired to tell an eland from a springbok." Thanks, Willis for an interesting story.

A note from **Hugo Hanson,** Course X, from St. Petersburg, Fla. advised that last June he suffered another stroke, I think his third, but that he was recovering slowly. So we are deeply shocked at the news of his sudden passing last November. He was one of my closest friends at Tech and we had kept in touch through the years. The sympathy of the Class goes out to Mrs. Hanson and the Hanson family.

Ralph Hyde, '12, from a portrait by his wife, Ruth, a professional photographer.

Arch Eicher continues to improve slowly after his heart attack and his wife, Agnes, writes that he is now able to get about with a cane. He, too, would welcome a note from any of us. It is tough on one so active to be confined. His address is 1718 Wood Rd., Cleveland, Ohio 44121.

Word of **Ralph Hyde,** Course X, received from his wife, Ruth, completes our news of the 16 Course X men who remain on the class roster. After graduation, Ralph worked in the chemical division of several paper mills located in Niagara Falls, N.Y., Springfield, Mass. and Longmeadow, Mass. He served in the gas defense division of chemical warfare during World War I. During the depression in 1931, he bought a farm near Taunton, Mass., and built a successful dairy and poultry business. This he managed until his retirement in 1962, when he rented the farm to others. Ralph's first wife, Elizabeth, died in 1940. He had three sons, two of whom are living and have families in Ohio and New York state. Their only daughter, Elaine, is married and lives in California. The Hydes are in good health and still live in Taunton in the same house. Ruth keeps busy as a professional children's photographer and Ralph finds plenty to do about the place with his vegetable and flower gardens. For a change in pace, they both enjoy taking auto trips about New England.—**Ray E. Wilson,** Secretary, 304 Park Ave., Swarthmore, Pa. 19081; **Jay H. Pratt,** Assistant Secretary 937 Fair Oaks Ave., Oak Park, Ill. 60302

14

Our correspondence of the past months includes an attractive card from **Harold Richmond** from Japan which explains why we did not see him at the reunion. He says that they were staying longer than they had previously intended, things were so attractive. We agree, from a limited experience that when it comes to gardens and parks there is nothing to compare, at least in this country.

A number of up to date addresses have accumulated: Henry R. Aldrich, 74 Maple Shade Rd., Middletown, Conn. 06457; Walter H. Monahan, c/o Miss Sara Monahan, 3 Governor's Rd., E. Milton, Mass.; James B. Reber, 8 Brier Hollow Rd., Houston, Texas 77027; Clarence B. Rogers, Apt. 311, Canterbury Court, 3750 Peachtree Rd., N.E., Atlanta, Ga. 30319; Summer Address: Thorn Dickinson, Elk Lake Lodge, Blue Ridge, N.Y. 12870; Lyman S. Baird, 3510 Front St., San Diego, Calif. 92103; Hampar T. Gazarian, 2800 Atlantic, Daytona Beach, Fla. 32018 —**Herman A. Affel,** Secretary, Rome, Maine, P.O. RFD 2, Oakland, Maine 04963

15

Happy New Year! with the hope that you and your families enjoyed a pleasant holiday season.

The Class Secretary Supreme

I want you all to share with me the pride and honor I have in receiving, from the Alumni Association, the award of a Bronze Beaver. The citation with it is particularly expressive and touching: "Class Agent, Honorary Secretary, Reunion Chairman, Committee Member and Chairman, leader of the Association of Class Secretaries, Alumni Council member, are just a few of the many ways he has served M.I.T. in his alumni career. But in his capacity as Secretary of his Class for over forty years, he has become so much the personification of alumni and class service that he is indeed 'Mr. M.I.T. Class of 1915.' " I am grateful for this and shall prize it highly. It was awarded at the Alumni Officers' Conference luncheon on September 5.

Just prior to the AOC a very interesting and stimulating gathering, a Workshop for Class Secretaries, was held at McCormick Hall, Cambridge on September 4. At the Alumni Officers' Conference, **Max Woythaler** and I represented our Class. Then on September 15, The Pirate and I were invited to a dinner and meeting for Reunion Chairmen of 1970 at the M.I.T. Faculty Club. The Alumni Association went all-out to make these meetings informative, helpful and enjoyable. Good show! **Ben Neal** attended the Alumni Seminar at M.I.T. early in September. It was good to see him here. He spent some time with our young friends Jean and Jack Mohr, '50.

At this date (early in October) 25 classmates, including **Mary Plummer Rice,** have indicated they plan to attend our 55th reunion in June. Keep up your interest and plan to be here with us. Great news for you—the Alumni Day Committee is breaking tradition and is preparing to provide us with an "on campus" social program starting at the cocktail hour, Sunday night, June 14, which will last as long as we can last. This should be a gala end to our return from our 55th at the Cape. Charlotte and Pop Wood celebrated their 50th wedding anniversary at their delightful place, Windy Row, in Peterboro, N.H. on September 16. Representatives of the Class who attended are pleased to report the young couple looking and feeling fine.

While visiting his family in Boston in September, **Sol Schneider** phoned me and it's good to report that Sol and his family and great-granddaughter are all doing well. He now plans to be at our 55th.

From Pasadena, **Frank Boynton** wrote: "Had a very pleasant and rewarding visit from **Robert Welles** recently. He presented my wife and me with some very luscious peaches grown in his home garden in Altadena. I also have some M.I.T. neighbors; Mr. and Mrs. Robert V. Bartz, both Class of '44. I hope to get better acquainted with them soon. I discovered that they were M.I.T. people when their beautiful teen-age daughter stopped to chat and she was wearing an M.I.T. T-shirt."

Horace S. Ford, Bursar at Tech during our time died September 23 in Cambridge. He served M.I.T. as Treasurer for many years. The alumni administration building is named in his honor. Jack Dalton and I attended his memorial service at the Baptist Church in Brookline, Mass. Jim Killian's eulogy was a splendid tribute to Horace.

We regret to report also that **Tsang Kyien Yuan** died July 25 in Shanghai, China, and that **Alfred H. Clarke** died September 13 in St. Louis.

Here's a condensation of some interesting letters from **Ernie Loveland,** who's had a really tough time with some serious

back surgery. If you'd like to write him, he's at Zamboango Hotel, Zamboango City, Philippine Islands. "On May 17 in Honolulu, I had surgery on my spine. I would have had it done sooner as I was getting worse rapidly but the Honolulu surgeon who was to do it was in Singapore for a month of lecturing and operating. The position of my difficulty was known, but the reason could not be determined until the operation. The surgeon has said that I should be able to return to work within a month and I hope his statement is correct, as I want to return and give this job a good clean finish. The University of Honolulu, having lost its financial support from the American sponsor, dug into its own pocket to carry on to the end of June at which time they will have to terminate it due to finances.

Just recently some very interesting questions have arisen in connection with our studies and I hope to be able to throw some light on them before we quit. Beyond that I believe we have not learned enough to be ready to try experimental commercial cultivation of the plant and thus increase the exports from the Philippines and increase the amount available for the American company which wishes to be assured of a large supply. We should also do some work on quality but the University cannot finance this work.

"I am very much interested in it and there are others also interested. A month ago one of the heads of the Philippine National Development Board called on me and said they wanted me to spend two to three years more on this project and talked as though there was no financial problem and that they fully expected the work to proceed under their sponsorship, but I feel that they expected the University to donate my services and I know that is impossible. Also the manager of Foreign Operations for the American company wrote me that he was coming to the Philippines and would see me in Zamboanga to talk about cultivation of the plant. But the Filipino who is manager of their Philippine purchasing operation has told me that he is doing his utmost to have me stay here. In addition a New York company has told me they want me to go to Madagascar for them if the present work ends in June. The main question is—what shape will I be in after the operation? Cost of living here is low but wages are lower yet and most of the workers have difficulty paying their way.

"The Fisheries Commission has been very helpful to me in my work and have from the beginning supplied me with two of their men who add to the two or three others paid by the University who are working for me. One of the men they hired for this purpose is on his first job, his pay is four pesos per day, about 26 cents American, but it has about the same purchasing power as a dollar back home. This fellow's father is ailing and has not worked for some time so he is trying to support the whole family on that wage. Some time ago he told me his kid brother had left school in order to help financially. He is about 13 years old and was working on odd jobs at the public market making 40 centavos per day, about 10 cents American. So I gave him ten pesos a week out of my own pocket and the boy went back to school. Now ten pesos isn't enough for me to boast about, but to him it was two and a half days' pay.

The restaurant in this hotel is on the top floor and overlooks the Strait of Bacilan, a very nice view which includes not only the water and the mountainous islands across the straits but also the city dock where there are usually a couple of good size sea-going vessels tied up, and between Zamboanga and the Islands there are usually many small outriggers engaged in fishing. Here in the tropics the length of the day is about the same the year round and when the sun begins to set it sets fast. I usually go up for dinner at about quarter past six to see the beautiful but short lived sunset across the straits and while the western sky is brilliant it is already black night in the east. Actually there is no twilight here. The sun sets and immediately it becomes black night. After dark the small lizards come out on the ceiling near the lights to feed on the insects attracted by those lights.

Zamboango prides itself on being the "City of Flowers" and many houses have bougainvillaea, frongi-pongi and hibiscus growing in their yards with orchids hanging from the tree trunks. Several times my helpers bringing in the sea weed samples from our collection off the beach have brought in sea horses. This is the first time I have seen this interesting fish taken from its natural habitat. There are many Chinese here, perhaps the following merchant's name will amuse you, as it did me—Go Soon Hung (what a sad event). Although I don't know why this name is used so often I have seen the Ever Hotel, the Ever Cinema and the Ever Educational Supply Store. An old time favorite of mine is frequently played in our restaurant—"Far Away Places With Strange Sounding Names." When they play it I always think that Zamboanga, Bali, Wasan, where my office and laboratory are situated on Cawa-Cawa Blvd. and Paluksangay fit very nicely into that song, but wouldn't Megansett, Sippican, Siasconset, near my home in Marion and Hackensack and nearby Hohokus and Hoboken be the same for the Zamboangoans?

Here's an example of New Guinea pidgen English which I had to study out here. At the end of a small bridge there is a sign 'Bris Bukarap Lik Lik Ka Tasol' which means in English 'Bridge buggered up little car that's all.' Another one 'Yu laikim dispela tok tok,' to you this is 'You like him this fellow language.' See how easy it is to translate! On the way to work I usually see big pigs grazing in the streets and around the houses. In addition to the jitneys furnishing transportation there are still quite a few horse-drawn calesas in use with room for two passengers. The jitneys charge 10 centavos per trip (2.6 cents American) and if it should be raining they run out of their way to deliver you to your door.

These next two letters came after his operation. "I was on the operating table in Honolulu for four hours. The surgeons cut off three rear spears from the corresponding neck vertebrae and then went inside the spinal column to disconnect the verbtrobral ligaments from the spinal cord itself in three different places. I was in the hospital six weeks learning to walk again. I do about one and a half miles each morning and again each afternoon. This means staggering along as though I were drunk, but I think I am improving slowly. Also by the doctor's orders, with five pounds tied to each ankle I do 700 lifting movements each morning and 1,000 exercises with four-pound dumbbells and repeat the same thing each night. With seven days a week on the job and these exercises I am pretty well exhausted. I have to wake up about 5:30 to get all that done and get to work nearly on time and I have to go to bed early to follow the orders 'plenty of sleep.' Besides these leg and arm exercises I stagger about one and a half miles at noon and the same at night. I am pretty tired most of the time and usually every step I take hurts. I am, however, noticeably improving my walking gait and I hope that improvement will continue.

"The six months change of wind here that started before I left the hospital in Honolulu has destroyed all my samples, so in spite of replacing them I have finally finished my data calculations up to date for two years. I had advised that we should change our location because of these windy seasons and they vetoed the change. I think I told you they had run out of money for the continuance of this job and so since July 30th I've been working without salary and living expenses. So I feel freer to handle the job correctly and at the end of this week I plan to inspect a few other locations and when I find a place which in addition to having proper facilities for working, will afford protection against wind and against thievery, which goes on the year round, I shall move our operations to that location and start the half dozen experiments already written up, but which have not been started because those samples which we are still putting out to please the University are only lasting about a week.

In the meantime my walking gait is still a staggering and exhausting one due perhaps mostly to arthritis which I am now fighting with medicines and three injections a week. I hope to see you all some day." I don't know what to say to all this or why Ernie wants to do all this out there, so I leave you to guess what I think. . . . Next month's column will give you the play by play of our local class dinner here on October 24. Keep thinking about our 55th and some way, meantime, you can "help Azel."—**Azel W. Mack,** Secretary, 100 Memorial Drive, Cambridge, Mass. 02142

16

To begin with, we don't seem to have a related set of notes this time—rather, it is more a gathering of varied thoughts and experiences from different people from all parts of the country and beyond. However, as we look forward to our 54th reunion in June, one thought or theme or item seems common, namely, that as time goes on, we have a number of new kinds of items of common interest. Odd things, on the lighter side relating to older years, amuse us more than they used to. Others among us seem to nod their heads when we tell about them. For example, your secretary's household has a getting-old pet, a reasonably well-behaved springer spaniel 15 years old. She isn't really much use any more, she wags her tail most enthusiastically when you appear, but she barks at the wrong garbage man. Some time ago she began whimpering at night, really disturbing some of our needed sleep. To try experimentally to overcome this, one Nytol sleeping tablet was given her each night at bedtime—so far this has been quite helpful. But how long it will work is still an open problem, and in discussing it at the vet's office, where the malady was definitely identified as "insecurity," we received several suggestions for possible alternatives if any were found to be needed. One of these alternatives, suggested by the capable assistant with a twinkle in her eyes, has amused us for some time, namely: "You might put your picture on her night table!" But now, back to business.

Another High Honor

Last month we mentioned an award by the Illuminating Engineering Society to Willard Brown, our eminent and internationally known illuminating engineering expert. This month we are proud to announce another award to another '16er, this one, the Lewis L. Dollinger Pure Environment Award, to **Gordon M. Fair,** Abbott and James Lawrence Professor of Engineering Emeritus and Gordon McKay Professor of Sanitary Engineering Emeritus, Harvard University, for his outstanding achievements in the field of sanitary engineering. According to an August press release, the Franklin Institute's award "will be presented during the Institute's Medal Day ceremonies on October 15. Dr. Fair, a noted scientist, has gained equally wide acclaim for his career in education and his inspirational teaching which has stimulated students throughout the world to practice his theories and teachings. His accomplishments in the field of research are numerous. Prominent among his achievements are his studies of the kinetics of water and wastewater purification processes in controlling anaerobic decomposition of wastewater organics over a wide range of temperatures and, the natural stabilization of benthal deposits in lakes and streams. Dr. Fair's studies laid the foundation for the mathematical formulation of both aerobic, anaerobic and heteroaerobic purification and treatment processes. . . . Dr. Fair's statistical and hydraulic description of sands and other particulates in connection with the resistance of filter beds to filtration and the behavior fluidized bends during washing revealed the properties of sands and other filters providing the basis for the Fair-Hatch equation. L. P. Hatch served as Dr. Fair's research assistant at the time. Dr. Fair gained recognition for his studies of the measurement of odor and taste intensities in terms of physiological responses in keeping with the Weber-Fechner law. Under the aegis of the National Research Council his studies of water disinfection identified the kinetics of disinfection by hypochlorous acid and hypochlorite ions as well as the chloramines relative to temperature and hydrogen-ion concentrates. . . . He was born in the Union of South Africa in 1894. He graduated from Werner Siemans Gymnasium, Berlin; received S.B. degrees from M.I.T. and Harvard, a Doctor of Engineering degree from Technische Hochschule, Stuttgart, Germany; and several honorary degrees."

No "Mañana" Stuff

From the greatest distance comes a letter from **Raef Alfaro-Moran** in San Salvador, El Salvador. Over the years Raef was indeed very busy in his homeland, had a coffee processing and exporting business, headed a firm of real estate developers of "one of the nicest residential districts in town," and helped organize and run the cement plant in his country. Five years ago he had a serious accident that partially crippled him and curtailed his activities. He writes: "had to go to Memphis, Tenn. for a second operation on my left leg. Results were satisfactory for a few months but the pain is getting bad again and I am somewhat of an invalid. I naturally retired after my accident five years ago. Have no special hobby but manage to pass the time reading, seeing television and being in contact with a few members of my family and a few friends. Cannot get wholly accustomed to the lack of work at my age, 78, for contrary to general belief in the U.S.A. we do not practice the 'mañana' stuff."

Now coming north we have word from our good correspondent **Jack Camp** in Mexico City. He is always delving into something different and this time he speaks of a paperback, *Curious Naturalists,* by Niko Timbergen, that he received from the American Museum of Natural History—"one of the best books of its sort I have seen, and gives a good picture of natural scientists and their ways of working and thinking. . . . These naturalists spend a great deal of time, effort and patience trying to find stimuli that elicit various responses, then they run tests under artificial conditions trying to check and prove their observational findings. From the descriptions in this book, I suspect many of the insects and birds and animals are much amused at the scientists and enter into their games with delight, trying to do just what the scientist thinks they should do." Jack says his dogs "try hard to learn what I try to teach them and once they understand what I want, and accomplish it, they are pleased as Punch and miss few occasions to show off their new accomplishments." Then Jack notes: "On page 290 Niko says, '. . . At every stage of research, the biologist has to be aware of the fact that he is studying, and temporarily isolating for the purpose of analysis, adaptive systems with very special functions—and not mere bits.' Yet biology itself is but a 'bit' of all knowledge. Could it be that he suspects, perhaps subconciously, that something is missing from all his studies—sapiens? If so, being a scientist, he cannot admit it for science reserves sapiens for homo. But is not homo an animal? Then where do you draw the line? May not all life be sapiens? And why stop there? When the temperature of water drops, why does one molecule of H_2O crystallize while its neighbor decides to remain supercooled water? The philosophy of the early Greeks included a concept of 'logos,' which was universal." Jack adds that this is not just blowing off steam, but rather mental wanderings, for it pleases him when he even suspects others might be having glimpses, however vague, of the universe as he sees it. Any comments?

Further north we reach Newport Beach in California to meet Kay and **Irv McDaniel.** Irv says they are moving from Westcliff Villa and have bought a place in Laguna Hills (Leisure World) near Emerald and **Ken Sully.** This should have been completed in December. As he writes (late September), Irv is thinking about the possible subject matter for his Christmas card for 1969.

From still a little further north at Seal Beach, **Lev Lawrason** comments on the 1969 reunion picture: "Everyone certainly looks in good health." Then, "Life here goes on as usual, that is, a visit to my two daughters where I can work in the garden, and other household duties. I have been lying here in Leisure World, Seal Beach, Calif., for five years now and like it very much. Don't see how one could live as well as we do for the reasonable cost."

In a September letter **Willard Brown** sounds just like himself, busy as all get-out in his many civic and professional activities in Santa Barbara, Calif., where he settled down nearly three years ago and married again (happily, adding another Dorothy to our 1916 list of wonderful wives). He writes, "Tonight I am going to an M.I.T. Club of Southern California dinner at the Proud Bird Restaurant near the L.A. airport to hear Bill Bergen '37, Course XVI, who is president of the Space Division of N.A. Rockwell, talk about his Columbia moon capsule—sounds good. They get out a pretty good attendance—had over 200 at a recent dinner at the still-very-plush L.A. Biltmore to hear Bill Lear talk about his steam car research and tests, etc." Then, "Still very busy. For example, this week includes L.A. tonight; Tuesday, at the City Council meeting most all

day representing our Grove Lane District Improvement Association, of which I am V.P.; Wednesday night, an I.E.S. dinner; Thursday night, dinner and ladies night at our men's garden club; Friday, a dinner of the local chapter of the Navy League." Willard tells of a recent visit to see friends in Seal Beach, talking with Irv McDaniel on the telephone, adding, "Irv and Kay spent a night in S.B. quite a while ago and we had them for a really delightful dinner at our local Biltmore Hotel." Summing up he says, "Nuf for the moment, but we do lead a simply delightful life. To be pressed and harried just a bit is good for you when you get as old as we are!"

Herb Gilkey, retired professor of Iowa State University, Ames, Iowa, speaking of his new book, *Anson Marston* that we covered in our July column, has this to say: "Anson Marston was indeed a great Dean, and a great engineer. Although the ferreting out of details and the cataloging and excerpting of 248 publications was admittedly tedious, it was an interesting task and something that needed to be done. The result was rewarding. The book has been surprisingly well received both by I.S.U. graduates and others. I deemed it a privilege to have known the Dean and to have been closely (though non-technically) associated with him during his last twenty years." And then for a bit about Herb himself, "Within about four months of 80, I am still in excellent physical condition (no comment as to mental) and continue to frequent my office with a one-mile walk each way. Incidentally our eldest grandchild (Ginny) recently graduated from I.S.U."

Vows Are Taken

Last month we mentioned the marriage of **Arthur Shuey** but now we have the official account, right from the September 14 issue of the *Shreveport, La. Times:* "Vows Are Taken By Couple in Chapel Rites.—The marriage of Mrs. Clayton Hines Whitman to Arthur Ferguson Shuey took place yesterday afternoon in the chapel of St. Mark's Episcopal Church. Dr. J. Lawrence Plumley officiated at the 4 p.m. ceremony in the presence of their families. The couple was attended by Mrs. Seymour Many and Dr. Fred Ratzburg before an altar enhanced with a mixture of fall blossoms in hues of yellow and white. A reception was held later in the home of Mr. and Mrs. Many for the members of the families. Here, flowers in muted jewel tones formed the floral decor. Mr. and Mrs. Shuey will be at home at 902 Prospect." Again, congratulations and very best wishes to both Art and our new Mildred!

From Bogalusa, La., we hear from Sylvia and **Vert Young:** "The long task of clearing up the debris left by Camille is under way but the progress is painfully slow. Torrid weather and now a plague of mosquitoes. The tung industry in Mississippi is wiped out. You never saw such utter destruction. Likewise, the pecan growers. Now another one is 'breeding and brooding' in the Caribbean but there's not much left to blow down or wash away on the Gulf Coast. Well, 'don't tell me your troubles, I have troubles of my own' as a friend says. Adios and our best."

Frank Ross wishes he could give us some exciting news but finds things "are going along about as usual; that is, smoothly, comfortably and not too hair-raising. We have moved and the new address is 3400 Gulf Shore Blvd., N., Naples, Fla. 33940. We are about one-eighth mile from the gulf and it's fun to play a round of golf and then go take a swim in the gulf. The temperature of the water is about 78° so it's almost like taking a warm bath. Have not minded the warm weather—we thought we might on this our first summer here, and so far have dodged all hurricanes."

Ed Hall reports that he has a new permanent address in Baltimore, 6009 Huntridge Rd., 21210, "out in the country where the air is better." Says: "We go to Marathon, Fla. this November and return for Christmas. Then we will go back about the middle of January to stay through April."

Fred Upton reports from Lanham, Md., that he had been in the hospital "for some cutting and sewing. Now feel at least five years younger and am able to do things I couldn't do before. I wrote about my experience to my daughter, Dr. Emily Upton. She asked permission to show the letter to her colleagues—an example of the patient's point of view."

Cy Guething reports that he and Gyps had a glorious summer in Boothbay Harbor. Whether it was "down Maine" or "up Maine" is something he says that **Ralph Fletcher** will have to answer, for Ralph has a summer camp in the state whereas he, Cy, was only a boarder. Then, "It is my way of thinking that the real Maine starts only north of Portland. Northeast of that is 'down east' whereas north of that up to the Canadian border is 'up north! And it's all God's country! You may recall that after the fateful election when Maine and Vermont were the only states to vote 'right,' a sign was erected at Kittery on the Maine/N.H. border that read, 'You are now entering the United States.' "

Speaking of state borders reminds your secretary of the hurt he received on an automobile trip as the family drove across the state line from Connecticut into Massachusetts some years ago. Road repair work was going on in both states at the crossover point. What bothered was that in Connecticut the warning signs read "Men Working," whereas across the border in Massachusetts the signs read "Men In Road!"

Do You Remember?

Over the past year or two, we have had some pleasant correspondence with one of our amanuensistical colleagues, Ray Wilson, secretary of the Class of 1912, and he has mentioned some interesting results when he has asked for contributions on the subject of "Do you remember?" We have one of these to report from **Bob Burnap** of South Orange, N.J., but his has a slightly modified slant. He wants to know if **Bert Ellis** remembers (and **Eddie Ekdahl** was also there) the "sterno fire on the carpet in our room which we put out with the all-cream cocoa we were making. I also seem to recall vaguely that we sacrificed a liberal supply of Nesselrode ice cream in the fire fighting operation but I could be wrong about that part. Memory is a fickle thing over a fifty-years-plus span." We can hardly let that go by without asking if you remember what it was that **Horace Bickford** found in his dessert in one of those dairy lunches not too far west of Rogers and Walker Buildings. Hm, a spike, two to three inches long, in a piece of apple pie! And just one more—do you remember the notice sent out by the "Picnic Committee" on June 5, 1916 that included the following: "Friday, June 9th, is the greatest day in the history of your lives. In the morning mail you will receive the final judgement notices. Read them and weep, then put on your old clothes and meet the crowd at the Trinity Place Station at 10 A.M. where we will take the train for Riverside Recreation Grounds. This is to be the last and best informal gathering ever held by the class of 1916. . . . There will be no spiritous lickers but plenty of cold pop and fresh water. Lunch will be served at the boat house at one o'clock. If you are particular what you smoke bring your own brand of tobacco. The 'makings' and class pipes will be supplied to all. . . . There will be a baseball game between the Summer Camp Trust and Jimmy Evans Course Two gang. The list of field events is as follows; three-legged race (Stewart twins barred); hop, step and jump (Charley Reed barred); Obstacle race (faculty barred); tandem race (Rusty White and Fats Rennie have withdrawn entries); wheelbarrow race; canoe tilting. Bring your favorite dice but watch McDaniel. Suitable prizes will be offered in each event except the latter." . . . The message was followed by a P.S. from Charlie Lord explaining what you were entitled to if you had paid your $8.00 assessment.

We just have to acknowledge the pretty little compliment received from classmate **Elsa Habicht Mueser** in Mountain Lake, N.J., about the little illustrative figures drawn on our secretarial dunning letter that is sent out for news. Such a reply with news bits is good pay indeed! Elsa also writes, "As we spend our days pulling weeds, at least the children and grandchildren go mountain climbing, ready for skiing in Zermatt, Switzerland. Keeping fit is still the slogan—even though television immobilizes many. Regards to the Class!"

As we write, we expect **Joe Barker** will be missing at the October monthly luncheon at the Chemists' Club (on the Thursday following the first Monday of each month, noon, 52 East 41 St., New York City) for he expects to leave for a Research Corporation meeting in Mazatan, Mexico in early October. Research Corporation is

Susan and Al Lunn, '17, display James Flaherty's, '17, painting of M.I.T.'s main entrance.

the foundation Joe headed after he resigned from the Columbia University School of Engineering in 1946 and until his retirement. He is still a Director and a member of the committee that selects the research grants applicants in our universities and colleges. We understand that about a million and three quarters is allotted each year. Later, at the beginning of November Joe expected to be in Palm Springs, Calif., for a meeting of the Society of the Sigma Xi.

From **Dave Patten** of Standish House, South Duxbury we hear, "It's been a fast moving summer if somewhat on the dry side. In mid-August, as is the family tradition, we motored to Cherryfield, Maine, stopping at the Tunk Lake Camp and at the ancestral home in town. Then on to Mill Village, N.S. for ten days, then back to see the grandchildren before they left for college, one entering Mills, another to Colorado and one off for Cambridge, England."

Earthmen & Nantucketers

From Virginia and **Joe Connolly** at their summer place in Brewster, Cape Cod, and before they returned to their winter abode in Tucson, we have an interesting thought or two: "In this age when Earthmen have at last walked on the moon, and on the very day when the new 'First Man On The Moon' postage stamps went on sale in U.S. post offices, I was again reading what I regard as a masterpiece of United States literature, Melville's *Moby Dick* and ran across this item. In this story, the author, describing a whaleman from Nantucket, writes as follows: 'The Nantucketer, he alone resides and riots on the sea. . . . there is his home. . . . For years he knows not the land; so that when he comes to it at last, it smells like another world, more strangely than the moon would to an Earthman.' These words appeared in 1851, more than a century before the astronauts reached the moon. Question: Did Herman Melville have any idea that Earthmen would some day reach the moon?"

The really big news, says **Will Wylde** of Stamford, Vt., at least the big news to Ann and Will, is the arrival of their first great grandchild, a girl, Dianne, born to their grandson Dick Marra and his wife Lois. "Both of them are last year students at Northeastern University, the educational giant grown from what in our time was the Boston Y.M.C.A. night school. They are both in Northeastern cooperative courses which I must say is a fine idea. After the first year of a five-year 12-month schedule, the plan consists of alternate periods of study and work in the student's chosen field, which gives the freedom of a self-supporting life. It has worked out very well in this case." Will and Ann go back to Bradenton, Fla. from October to the middle of May. "Last winter **Free Clarkson** and his wife dropped in to see us in Bradenton and we had an enjoyable visit."

Finally, the best wishes of your class officers—President **Ralph Fletcher,** Vice President **Joe Barker,** Treasurer **Francis Stern,** and your two secretaries listed below—for a Happy and Healthful New Year. And do keep in mind the really outstanding pleasure that is assured when you and yours join the rest of us at the 54th reunion in June—more details in later issues. You can be sure that appreciation will be high if you continue to write a little but write often to your ever-willing-to-work secretaries.—**Harold F. Dodge,** Secretary, 96 Briarcliff Rd., Mountain Lakes, N.J. 07046; **Leonard Stone,** Assistant Secretary, 34-16 85th St., Jackson Heights, N.Y. 11372

17

Happy New Year to you one and all. Our 52nd reunion held October 8 and 9 was moved to a new location, Northfield, Mass. The Northfield Inn, located in the rolling country just south of the New Hampshire/Vermont border, dates back to 1880, but is well maintained being continually modernized. The beauty of it all was enhanced by the fall foliage. Dud Bell's letter of September 20, said: "I doubt if the lateness of the letters going out will make any difference." He was so right as the attendance increased over our 51st, stepping up from 52 to 60. Besides the beauty of the handscape, Northfield has the Pine Street Historical Museum, the Moody Museum and in the carriage house was Mrs. Webster's painting exhibit. Some early arrivals were there on the 7th, namely George Henderson, Ed Aldrin, Sr., the Penn Brookses, the Frank Butterworths, and the Proctors. On the 8th, an overcast and somewhat rainy day, the arrivals continued up to the total of 60. In addition we had the Stan Dunnings, the Don Severances, the William Neubergs, the Stan Lanes, the Dudley Bells, the Brick Dunhams, the Phil Cristals, the John Holtons, the Al Lunns, the Bill Dennens, the Ray Stevenses, the Leslie Fords, the Bill Hunters, the Ken Bells, the Art Gilmours, the Phil Mahers, Ken Lanes, the Tubby Strouts, the Ralph Rosses, the Al Ferretties, the Ray Maeders, and the Alan Sullivans, accompanied by their son and daughter-in-law. Soloing were Clarence Seely, Miles Demond, Ray Brooks, John De Bell, Loosh Hill and Frank Peacock.

Frank Peacock who resides in Rockford, Ill., came the farthest and really would have been entitled to the long distance trophy. Maybe by our 55th we can sponsor a new trophy as the old one was retired by Ras Senter.

Now as to statistics, announcements were sent to 317 including the six honorary members, plus 52 widows. One hundred six cards were returned of which 49 recorded some comments for latter editions of the *Review*. Only eight of the widows reported back. Our **Ann Parker** telephoned Dud and he, being an honest man, advised at the time no widows gave intention of attending, however, she made a reservation which she later cancelled, honorable mention for your efforts, Ann. Apparently transportation was not the problem as Phil Cristal tried to get two of the gals to accompany him and Rom.

There still remain a few golfers—adjoining the Inn is a rolling nine-hole course, par 72. Guess we needed **Ray Blanchard** to M.C. the tournament play as there were no score cards turned in or comments heard as to birdies, bogeys, or holes-in-one. Those seen headed for the club house, were Ray Stevens, Phil Maher, Ken Lane, Will Neuberg and George Henderson. Two tennis courts only attracted the Severances, Phyl and Don and the former was in better form. The horse back riders did not appear other than **Penn Brooks** who alibied he forgot his breeches but had his boots. It was

noted that **Enos Curtin** was doing his riding in Ireland again. We gathered for dinners and luncheons in the Campus Room on the ground floor which was perfect for the group. At the dinner on Wednesday the 8th, Al Lun announced the Class scholarship fund to be known as the Buzz Aldrin Scholarship, to be activated at the 55th reunion. All contributions to the Alumni Fund for the next three years will be credited, if so designated, to the Buzz Aldrin fund. Also any undesignated donations will be included. This announcement was unanimously approved. Based on past Fund contributions and some special gifts for 1968-1969, it is anticipated that the scholarship will reach $100 thousand at the time of our 55th reunion. **Ed Aldrin, Sr.** was asked to comment and he arose and was brief and to the point, "I am in favor and hope it is a success."

Also it was the class pleasure to present to the John Holtons, and the Ray Blanchards, in absentia, illuminated scrolls commemorating their 50th wedding anniversaries. These handsome scrolls were the artistic work of our Ken Bell. Then followed movies of the Apollo 11 flight and Buzz's walk on the moon. The reel was supplied by Ed Aldrin, Sr., and ably projected by Stan Lane. Stan then showed movies of his trip from Calcutta, India and west to Spain. This concluded the first evening's program, and left over for the 53rd Reunion is an album of Apollo records. Also tabled was the October, 1912 edition of "The Review" of the Lowell High School showing some of the early artistic work of our Nelson Chase, who was also editor-in-chief. This copy was thoughtfully sent to us by Harold Dodge, '16.

Thursday the 9th following breakfast, **Ray Maeder,** our Johnny Appleseed, opened up his roadside stand—the trunk of his car—exhibiting cartons of beautiful apples and pears. Each year they seem to be bigger and better. We each happily relieved him of a bag full. That afternoon was highlighted by a piano recital by Sue Lunn and Ken Bell.

At the banquet that evening presided over by our president, Al Lunn there followed the usual procedure of reports by the treasurer and secretary. Al brought up the matter of the Alumni Fund Insurance program instigated by our late Ted Bernard. This Fund has been held as a capital fund with income accruing which now totals $98,333.02. It was voted that upon its reaching $100,000 further income would revert directly to the Institute's Alumni Fund and $100,000 would be a permanent Class of '17 fund.

For an excellent job as reunion chairman for the past two years Dud Bell was presented an engraved silver dish. An award of a red blazer was made to Nelson Chase who produced the Rodgers painting. To overcome the cry of collusion at our 51st when the Proctors drew the winning number for the reproduction of the **Nelson Chase** mural, a second reproduction was presented to Rom Cristal and Jim Flaherty, (in absentia), whose numbers were not included in the raffle. Ed Aldrin presented Al Lunn with a token of our esteem for his services rendered the Class over the past year. After the meeting Stan Lane showed slides of previous reunions, and our 52nd became history.

Ending in a sad note—**Horace Sayford Ford,** honorary member of '17, passed on September 23. Memorial services were held on the 26th at the Baptist Church in Brookline, with James Killian giving the eulogy. Attending were our Al Lunn, Ray and Katherine Stevens, Jeanette and Stan Dunning, the Killians and the Johnsons and Don Severance. To us '17ers and to M.I.T. he was a great person.—**C. Dix Proctor,** Secretary, P.O. Box 336, Lincoln Park, N.J. 07035.

With sadness the death is announced of our Secretary, **C. Dix Proctor.** He suffered a coronary on November 30 and appeared to be making a good recovery when he suddenly passed away on December 13. Further information will appear in the February column.—**Stanley C. Dunning,** Assistant Secretary, 6 Jason Street, Arlington, Mass. 08174

18

At the risk of being labelled provincial and chauvinistic, I like living in the Boston environs. One of its blessings is the privilege of seeing how M.I.T. has developed since our student days. One of the things we missed then was a University Chapel. Happily that void has now been filled.

I will not describe in detail the Chapel—suffice to record it is dignified and architecturally unusual. Located in a rather secluded corner of the green in front of the Kresge Auditorium and the Stratton Student Centre, it is a red brick circular structure surrounded by a moat—severe in design but lending itself to an atmosphere of quiet and meditation. I have made it a point with visitors from near or far who want to see Tech to bring them to the Chapel. In all instances they have been moved, as I have, by the mood of peace and calm it creates. We have all been most favorably impressed to see its many uses by all religious denominations by the M.I.T. family. I recommend that all of you who have not so far been in the M.I.T. Chapel to make it a "must see" when you come back to your Alma Mater.

And now to the news of the month from many parts of the world. From the greatest distance comes this interesting note from **Ernest Grunsfeld:** "Yours of August 26 with a plea for an autobiography just reached me here in Paris. In January 1967, 'Maggie' (Alex Magoun whom I knew well at school) tracked me down with a similar request to which I responded at length. It was published in the April 1967 class notes. A sad note—he responded with a delightful letter whose last words were to the effect that we should remember we are not immortal. Prophetic, because I believe he died not long thereafter.

"Since then I have had my big celebration in the Poconos' with nineteen children and grandchildren to help. I have also continued painting both before and after two cataract operations which were successful. Each morning I bless the man who first had the idea to put some pieces of plastic in his eye because with the contact lenses I wear, I see as well as I ever have with a slight shift in color perception, i.e.: I see much more of the cold colors of the spectrum including ultraviolet. A really good painter Claude Monet had the same operation in 1920 and continued to paint for almost 10 years thereafter. His range of colors changed, however, with more emphasis in the blues and purples which is what has happened to me.

"My wife and I spend about half the year here in Paris and divide the other half between home and travelling. After 20 years here, this is still the loveliest city I have ever seen and it is a delightful one in which to live. . . . Has Max Seltzer ever sketched out a full autobiography in the class notes? I think I remember a part of one. In any case, I have admired your 1918 notes for some time."

It has been a long time since some of the classmates have made an appearance in these columns. I welcome this one from **Howard Cyr** and urge some of you to follow suit and promptly:

"Your patience and good nature in urging old reprobates like me to write of their doings is incredible. I can hardly believe that anyone else could possibly be interested in my very normal experiences since leaving M.I.T., but here are some notes. After M.I.T. I joined Professor W. K. Lewis' 'Emergency Squad' working on poison gases, gas defence and other aspects of chemical warfare. At least three of my associates in this work became famous in their later activities, namely Robert Millikan, E. R. Bridgewater and Harold Weber. When the war was over I signed up with the New Jersey Zinc Co. as a research chemist and metallurgist, and stayed with them until I retired. My work was very interesting as I became Supervisor of Metallurgical Research. I wrote a book on zinc and cadmium metallurgy and was granted quite a few patents for processes in this field.

"On the non-technical side I have given much time to civic affairs, serving as chairman of the Lehigh Valley section of the American Chemical Society and as president of the Palmerton Memorial Park Association. Now I alternate between my homes in Pennsylvania and in Ft. Myers Beach, Fla. In the latter place I am often visited by my old M.I.T. friends and here's hoping that more will look me up. That includes you, Max. The main attractions in Pennsylvania are the lovely summer weather, my old friends and a number of lively grandchildren.

"I think that an interim reunion in Florida next spring is an excellent idea. I would certainly attend with my wife if at all possible. April or May would the best months, as many of us migrate north by June."

Here are observations on a proposed interim reunion this spring. Please send me your ideas so we can put together a program as soon as possible.

Thomas Knowland: "I hope you will forgive me this letter which is a belated reply to your note of August 26. I do think an interim reunion in 1970 would be just fine, and since Hazel and I will probably be in this general area, we would be pleased to attend. The biographical 'thing' is something else, but maybe I can spell it out one of these days; meantime Max, please accept congratulations for your fine effective work as class secretary."

Len Levine: "I think a reunion of 1918 is a good idea anywhere at anytime. However I would prefer it here as I am still travelling and it is not easy for me to be absent during the school period. I like your idea of contacting our classmates for reviews. I read the 1918 notes with considerable interest (if they are not too long individually). It would be nice to hear from some of the members who have been silent for many years. Happy New Year."

Frederick B. Philbrick: "I have just returned from a six-week visit in California, and upon my return received a call from Harry LeVine, advising me about the suggested reunion of our class in Florida. You can be sure that I will be glad to help in any way that I can.

"Perhaps you did not know about the passing of one of our classmates, **Jacob Young,** of Winthrop, Mass. He was one of my closest friends while we were at the Institute, and I have kept in touch with him over the years, although not as closely as I would have liked. If you wish further information about him, I suggest you call his sister, Miriam, who still lives at the family home at 65 Johnson Avenue, Winthrop, Mass.

"We had a very pleasant visit in California seeing old friends and associates. I lived there from 1929 to 1943, so we had a lot of ground to cover. We made our headquarters at Los Angeles, and later at San Francisco, and stopped on the way home in Phoenix, where the son of one of my old friends from Pasadena was City Manager. . . . I would be very happy to have a reunion of our class somewhere in Florida, preferably in the South, and trust that you will keep me advised as to any developments. . . . I am glad to say that with my pacemaker, my health is very good, and I find plenty to keep me busy. With kindest personal regard to you and your wife."

I add one note to this letter from **Frank Wells**—he told me when he was here that he expected to be at our spring reunion, preferably in Florida. "I enjoyed talking with you at the Alumni Symposium. I didn't see you on Monday, but neither did I stay past the coffee break because of the threatening weather. They had promised to tell us at noon what the background of the S.D.S. demonstration was, and I was sorry to miss that, though it really was nothing unusual these days. Now that the seminar is over, I'm not sure what I did learn from it except that somebody ought to do something. In my last week I was told that semi-private rooms in the New York Metropolitan are $90.00 per day, and everything is extra, even an aspirin. I'd judge from that, that the total cost runs about $270.00 per day if the patient has as many tests as I did during my months stay in Harrisburg which Medicare covered. It was a pleasure to meet your wife and this letter is really to take the official farewell of you both which I missed doing in Boston."

A recent issue of the *Boston Globe* produced this story on **Sam Chamberlain.** "Boston can lay claim on scads of well-lettered historians. . . . But precious few of these familiar New Englanders, if any, can turn out Filet of Sole Valencia or Truite Farcie Dede—WITH Sauce Mousseline—and an etching of the inn where these masterpieces were first dreamed up, together with a description of the little village that makes you reach for your passport. . . . If you have a treasured copy of Bouquest de France or its Italian or British counterpart, then you know there is no one quite like Samuel Chamberlain of Marblehead.

"And there is nothing even in our most rose-medallioned and grandfather-clocked Beacon Hill purlieus, to match the glorious old house where Sam and Marcissa Chamberlain live and work together. The patina of treasured things, a Breton chest, a Louis XIV panetiere, a Burgundian cabinet, are warm in the sunlight. Herbs and wine wait, fragrant with promise, on the French refectory table in the old pine kitchen where Williamburg friends covet the rare (and exceedingly comfortable) old chairs from an early country church in France.

"Master architect, etcher, photographer and connoisseur, Sam Chamberlain is a host with few equals and his decorative wife shares his discerning eye, his gift for the perfect thing in exactly the right place. Her own talents are considerable, even shared with the preparing of nearly 200 books plus uncounted articles for *Gourmet* or publications here and in other countries."

Thanks to Mal Barber we reprint the notice from the *Yale Alumni Magazine* of July 1969, concerning the conferring on **Bill Foster** of a well deserved honorary Doctor of Laws for his years of devoted public service to the United States and to a more peaceful world.

"Leader in the execution of the Marshall Plan, high officer in the Pentagon during the period when aggression was met in Korea, constructive business force over a lifetime, you have dedicated your life to the control and reduction of the deadly arms which technology has brought forth in our era. Your patience and ability to keep the faith amidst the scorn of the cynic and the gloom of the realists made it possible to achieve international agreements to ban the testing and limit the spread of nuclear weapons. Your counsel has been a model of enlightened public service to your country and to humanity as you have pointed the way toward the sweeping changes, from sword to plowshare, that must come if mankind is to survive and to develop in peace. Yale confers upon you the degree of Doctor of Laws."

It is with sorrow that I record the death of **Marvin Pierce.** His wife sent me notice with a most touching note from which I quote in part. "I cannot picture anyone who was more cheerful in the face of business adversity, nor more objective in his attitude towards people. He believed in everyone and in the United States." The following is from *The Rye Chronicle,* Rye, N.Y., July 24, 1969. "Marvin Pierce, 76, former president of the McCall Corp., who lived in Rye since 1924, died last Thursday afternoon at his home on Stuyvesant Avenue. . . . Mr. Pierce joined McCall in 1921 as assistant to the publisher after two years of work as a civil engineer. He was named vice-president of the company in 1926 and in 1946 was made president and chairman of the board. . . . In 1958 he retired from McCall to become a consultant —first for Time Inc. and then, later, for the Cowles Publishing Company's Look Magazine.

"In 1965 Mr. Pierce was named a consultant to the International Eexcutive Service Corps which aids developing countries and he traveled to Brazil in 1968 to serve as advisor to a magazine publishing house there. He retired later that year. During World War I he served in France as a first lieutenant with a battalion of the Army Corp of Engineers going overseas late in 1918 and returning to the U.S. in 1919.

"His first wife, whom he married in 1918, was the former Pauline Robinson who died in 1949. She was the mother of his four children. He married Willa Gray Martin of Greenville, S.C. in 1952 who survives him. In addition to his wife, of the home address, he is survived by the four children of his first marriage."

I talked to Dorothy who reports **Ed Rossman** is making a steady improvement after a recent operation. They were to leave about November 1 for Tucson, Ariz., for the winter and expect to return to Paris, Maine in the spring.—**Max Seltzer,** Secretary, 60 Longwood Ave., Brookline, Mass. 02146

19

Timothy E. Shea served on the program committee for the 1968 Annual Meeting of the National Academy of Engineering.

The main theme was the process of successful technological innovation, and dealt with promotion of understanding of social and environmental factors that influence management and governmental decisions.

Nelson Bond received a Certificate of Excellence for his special work in the Pentagon. . . . **Jack Stevens** wrote to say: "Genevieve and I had a perfectly wonderful experience out at Chatham Bars Inn and at the reunion luncheon the following Monday in Cambridge; I think everyone really had a good time." . . . **Franklin S. Adams** checked in with a note about reunion. . . . **Lloyd Sorenson** wrote: "Winnie and Sorry had a wonderful trip to our 50th class reunion in June. Our accommodations at M.I.T. and program arranged by the Alumni Association were excellent. Meeting my classmates in Cambridge and at Chatham Bars Inn after five years was a very rewarding and delightful experience."

Virginia writes that her husband, **Albert Reynolds** has been very ill and has been in the hospital since April 22. He is now just beginning to recover.

We were sorry to hear of the death of **Will Langille**'s wife, Joanne, who had been ill for many months. She was very brave to attend our 50th reunion and all who got to know her, grew very fond of her and greatly admired her courage and spirit.

Larry Riegel and his wife are starting a South American cruise the end of January, with stop overs in various countries. The trip should be most interesting.—**Eugene R. Smoley,** Secretary, 1111 Casuarina Rd., Delray Beach, Fla. 33444

20

In this, '20's proudest and most auspicious year, your secretary congratulates his classmates, one and all, and wishes each and every one a year of good health and full enjoyment of the exciting changes and advances wrought by the men of science and engineering in the past 50 years. Surely we should be profoundly grateful to have had the privilege of active participation in this wondrous half-century since graduation.

From this lively group of grandpas, which is undoubtedly much too busy and active to find time to communicate with the secretary, a few gleanings of news find their way down to him. **George A. Wilson** of 38 Worthington Circle, Braintree, Mass., sends pleasing word that he is enjoying life and his several hobbies including oil painting, ornithology, mineralogy and metal detecting. . . . **Ben Morse** has settled down in Hessel, Michigan, which is way up near the Sault Ste. Marie locks. Must be plenty of snow up there. . . . **Ernie Huntress,** emeritus professor of chemistry at M.I.T. and emeritus secretary of the graduate school, may be found in nearby Melrose, address 585 Franklin St. . . . My far-flung spy network reports that Gladys and **Foster Doane** have been seen at such exotic places as Dubrovnik, Yugoslavia and elsewhere in Greece and Italy. Foster, whose interests in pulp and paper-making technology are international, was probably combining business with pleasure.

Isaac B. Simon of the Department of Nutrition and Food Science at M.I.T. has collaborated on a study of the surface tension of food juices and his findings are presented in a paper in the publication *Food Technology* published by the Institute of Food Technologists. . . . **Heinie Haskell** who once resided in Brunswick, Maine and went to Bowdoin before he joined our Class, is reported alive and kicking by our well known summer residents of Maine, namely Buck Clark and Jim Gibson.

It is with profound regret that your secretary reports the death on September 11 of **Edmund C. S. Bigelow** of 9704 Mt. Pisgah Rd., Silver Spring, Md. News of the decease of another popular classmate has also just been received. **Alton S. Pope** of 105 20th Ave. S., St. Petersburg, Fla., passed away on July 8. I speak for the entire Class in extending heartfelt sympathy to Mrs. Bigelow, Mrs. Pope and their families.

As these notes were about to be put in the mail I was fortunate enough to enjoy a chance encounter with **Dorothea Brownell Rathbone** who, chipper as ever, was walking briskly along Tremont St. in Boston. Dorothea, who promises to be on hand at our fiftieth, says that the summer raced by before she knew it and expressed positive satisfaction with life at our present age. I am happy to report that she hasn't changed a particle and continues "full of beans."—**Harold Bugbee,** Secretary, 21 Everell Rd., Winchester, Mass. 01890

21

Happy New Year! Travel seems to be the major subject of the welcome communications from members of the Class this month, many from sunny climes which, at least, provide a psychological relief at this time of starting the North American winter. Eddie and **George F. Gokey, Jr.,** who use their home address, 98 Westminster Dr., Jamestown, N.Y. 14701, principally as a point of reference for their wide and extended swings around the globe, wrote from Italy to send best regards to the Class. They continue: "We're back on the continent doing Florence again. Last time we missed a lot of their art treasures so we're giving a good 'look-see' this time. Still summer here and the city is crowded with tourists. An antique show is open. We visited the Pitti Palace today."

Rigi and **Saul M. Silverstein,** 28 Stephen St. Manchester, Conn. 06040, were scheduled to return in mid-December from about 12 weeks in the Far East, Australia and New Zealand. They left Seattle, on Saul's 27th foreign trip since 1952, for Tokyo, where he was the United States representative to the triennial International Management Congress. The Silversteins took a tour of Japan's Inland Sea, Nagasaki and Hiroshima. Besides the visit "down under," the trip included Hong Kong, Macao, the Philippines, Thailand, Malaysia, Singapore and Indonesia. In addition to sightseeing, Saul lectured on management and carried on some business contacts for Rogers Corp., of which he is chairman.

Attractive New Zealand

Philip H. Hatch, 70 Gibson St., North East, Pa. 16428, writes, in part: "Have meant for some time to write that I had a telephone conversation with **Harry P. Field** in Honolulu last April. We have a good friend who lives in the same apartment building and who knows the Fields quite well. The occasion for being in Hawaii was a stop there on our return from a cruise from San Francisco to New Zealand and Australia, including assorted South Pacific islands. We went with John D. Bowman, '20, and his wife, who live at 22 Penhurst Pk., Buffalo, N.Y. John, who has also retired, was graduated with us in Course VI. I'll never know and I don't think he will either, just why he was assigned to the Class of '20. Due to the wartime confusion, he was at one time or another with both '19 and '20, but he spent most of his time with us.

"Of all the 33 countries we have visited in our travels, New Zealand is the most outstanding. We can recommend it to others, particularly since it is not yet overrun with tourists. I get a great deal of pleasure reading your excellent class notes in the *Review.*" We, too, would like to visit New Zealand, Phil, to look up a branch of the Clarke family which has long lived there. Phil retired in 1964 as chief mechanical officer of the Long Island Railroad and has recently been engaged in consulting. Daughters Barbara and Eleanor are married; Marion is single. There are five grandchildren.

Kodak shots on the veldt

William L. Knoepke, 3020 N.E. 40th Court, Ft. Lauderdale, Fla. 33308, who retired in 1957, completes one of those frequent coincidences which often make us wonder whether ESP was another art which members of the Class acquired at M.I.T. Bill writes: "Replying to your question printed in the July/August '21 Class News, our only home is here in Florida. About a year ago we moved to our present house in a better location on a canal just off the Intracoastal Waterway. While Marjorie and I were on a trip last fall to the South Pacific, I had some mail forwarded to my daughter in Severna Park, Md. Someone in the post office had my address for *Technology Review* changed to there erroneously. We enjoy travel and leave tomorrow by air for a camera safari in Africa.

"I am reminded to tell you that three years ago we took a cruise around South America. John D. Bowman, '20, who was also Course VI, was aboard, and together we had dinner in Buenos Aires

with a third Course VI man, **Philip H. Hatch,** who had come on another ship after finishing a consulting assignment in Brazil. Among my hobbies, I enjoy playing popular music on the organ. I quit the sax, which was impractical for an amateur, in favor of keyboard instruments, including the accordion and piano. Have you kept up your music? We are planning to attend the 50th reunion. Meanwhile, if you are near Ft. Lauderdale, please call as we would like to see and entertain you. Most of our northern friends have been down here."

Thanks for the invitation, Marge and Bill; since we're at the northern terminus of the Intracoastal Waterway, we wish it were a simple trip down. The violin hasn't been out of its case (decorated with miniature Tech Show posters) for years and we satisfy our craving for music with a hi-fi and regular attendance at symphony concerts. The Knoepkes have two married daughters and six grandchildren.

Madeline and **Ralph M. Shaw, Jr.,** 608 Riverbank, Beverly, N.J. 08010, have just arrived home as we prepare these notes. In response to a phone call, Madeline says she had fully recovered from her illness last summer and enjoyed the trip; Rufe was at a vestry meeting and we didn't get the opportunity to thank him personally for the complete sets of stamps he mailed from each stop abroad, Madeira, Lisbon, Madrid and Rome, where he also put together a complete set of current Vatican issues. All of this in torrential rain in Spain and extreme heat in Italy! The Shaws went next to Lebanon and Iran, despite touches of the "travelers' " disease. Rufe says: "Beirut was interesting but hot. Lebanon does not want to fight Israel, but the Syrians come over from Damascus to be able to attack Israel from Lebanon so as to make Israel attack Lebanon. 'Ain't politics grand?'!"

The tour continued to Athens but there is a gap in Rufe's running account because two letters from Iran did not arrive, probably because, as he says: "Nobody seemed to know the correct air mail postage and 'United States of America' should have been written in Pharsee on the envelopes." Our thanks to a swell pair for the news and the gifts.

Remember East Machias?

Wallace T. Adams, 2606 Fleming Rd., Middletown, Ohio 45042, wrote a long letter saying, in part: "Since you prepared the vignette in the June, 1969, issue of the *Review,* I have been made vice president of the Butler County Planned Parenthood Association. It is interesting and different. We are doing effective work with a colored group and the Appalachian whites. One of my daughters-in-law heads a clinic operating here. When Anne and I came east last summer, we stopped one night in Canandaigua, N.Y., but did not find Bertha and **Robert S. Cook** at home. Possibly they were still at their home in Ft. Lauderdale, Fla.

"We did have a fine visit with Blanche and **Charles A. Breed,** who receive their mail via RFD 4, Laconia, N.H. 03246. They live year 'round on the shore of Lake Winnipesaukee in a house Al has remodeled to give a beautiful view across the lake with the White Mountains in the background. Al looks fine. He is either puttering around or towing the grandchildren on skis behind his boat or behind the snowmobile during the winter. He and Ocy have two married daughters and five grandchildren. Al retired in 1962 as president and treasurer of the C. A. Breed Co., Newtonville, Mass., heating and fuel oil dealers. We stopped in East Machias to look across the lake at old Camp Technology. Several of the Smiths—relatives of Lory, who had the Model T touring car in my days—told me that the camp was not now getting much use. We were too early to see Jim Robbins, '23, who still has a summer cottage on Gardner's Lake. He was one of my students and son of the late Professor Robbins, '86, of the Civil Engineering Department. On our way home, we had a visit with Emma and Al Lloyd in Westerly, R.I. Our younger son, David, has sold his home in Topeka and is here in Middletown trying to buy a house."

For the record, **Leon A. Lloyd,** 35 Spruce St., Westerly, R.I. 02891, Chairman of the Interim Reunion Committee of the Class of '21, has made a final report on our fourth interim reunion, held in Mexico last March, and adds that he assumes both he and Co-chairman **Ed Dubé** are now discharged. These two and their respective wives have done an excellent job and we want to express the sincere thanks and appreciation of everyone for their very considerable work and the outstanding success they achieved. As to discharge, our answer is a firm and decisive "No!" Emma and Al report a family reunion with their three children, the respective husbands and wife and the five granddaughters at the time of Westerly's 300th anniversary. The two have been busy working on their home, for the Girl Scouts and the United Fund but did occasionally find time to head for the beach at Watch Hill for a swim.

More "retirease"

Vina and **Ray D. Cooper** have left Chicago after these many years and have a new home on Long Island, N.Y. Ray wrote to Class Vice President **Irving D. Jakobson** that he retired last October from active duty with the Produce Terminal Corp., Exchange Bldg., Union Stock Yards, with whom he had been associated for 47 years. He had been general manager and executive engineer for 25 years. Ray added: "Vina and I are in the process of moving—a terrific job and I hope we survive. Our daughter and her husband want us to take a small house about two miles from where they live. Our new address is 14 Ash St., Garden City, N.Y. 11530." Ray is a former vice chairman of the Chicago section of the American Society of Mechanical Engineers and was active in the Saddle and Sirloin Club and the South Side Swedish Club, both Chicago. He and Vina have made good use of their spare time in travel. The Coopers have two grandsons.

Horace B. Tuttle, 654 Park Ave., Bloomfield, Conn. 06002, has written to Betty and Assistant Secretary Sumner Hayward that: "After 43 years in the industrial insulation contracting business—pipe covering and other insulation mostly for new commercial buildings—I finally have retired." Tut was associated with the Johnson Asbestos Corp., West Springfield, Mass. A numismatist and former president of the Hartford Numismatic Club, he also has been active as past secretary of the Hartford Kiwanis Club and in amateur tennis tournaments. Pearl and Tut have two sons and two daughters, all married, and 13 grandchildren.

Ralph E. Ferdinand writes that mail should now be addressed to him in care of General Delivery, Brewster, Mass. 02631, instead of to Marshfield, Mass. We assume Fritz has now retired as president and general manager of Joslin Show Case and Fixture Co., Cambridge, manufacturer of store equipment. Eleanor and Fritz have two sons. . . . **George B. Wetherbee** reports a move from Birmingham, Mich., to 45 Eastern Prom 7H, Portland, Maine 04101. This must be a second retirement for George, who originally retired in 1944 as design and development engineer of the Fore River plant of Bethlehem Steel's shipbuilding division, Quincy, Mass. In Michigan, he had served as a financial trustee. He and Margaret have a son and daughter, both married, and seven grandchildren.

First class mail

Joseph C. Morrell, 90 Bryant Ave., Dorset 5B, White Plains, N.Y. 10605, who has been chairman of the southern area of New York State on **Irv Jakobson**'s 50-Year Gift Committee, says he now also covers New York City since **Dick Windisch** retired and moved to Naples, Fla. . . . **Augustus B. Kinzel** is reported by *The Bridge,* published by the National Academy of Engineering, to have been appointed to the Academy's committee on membership. Gus was a founder and first president of the Academy.

Report hath it that **Lewis W. Moss** could not be reached at his last known address, 630 Cherry St., Mt. Carmel, Ill. 62863. Where are you, Lew? . . . Also that **Herbert W. Gwynn,** whose last known address was 207 East Ohio St., Chicago, Ill. 60611, is no longer in Chicago. Can anyone supply his address? . . . **Edward P. Molloy,** 880 Lake Shore Dr., Chicago, Ill. 60611, has returned from an extensive visit in Europe.

Class Agent and Estate Secretary **Edmund G. Farrand,** 5981 La Jolla Mesa Dr., La Jolla, Calif. 92037, writes, in part: "**Samuel E. Lunden,** partner of Lunden and Johnson, prominent Los Angeles architects and planners, is building the 23-story Good Samaritan Hospital in the heart of Los Angeles and, at the same time, carrying on a lot of other high level activities in the interest of M.I.T. and local civic progress. Occasionally he

crosses the country for a breather at his home on Cape Cod. Daughter Alice is a virtuoso on the base viol in the Oakland Symphony and, I believe, in one other symphony orchestra.

"We had a fine visit from Marion and **George A. Chutter,** who were out here to see their son off to Subic Bay for three years of service there. Last week, we dined with Rosalie and **Edwin L. Rose.** Ted is working at top speed in the Empire Research and Development Corp., San Diego, of which he is president. Rosalie is active in sculpture and various community projects at their home, 397 N. Lima St., Sierra Madre, Calif. 91024." Helen and **Ed Farrand** have sent us several lovely color views of the scene from the patio of their home and the tremendous panorama overlooking San Diego and the ocean.

A later note from Marion and our 50th Reunion Chairman, George Chutter, Box 305, East Dennis, Mass. 02641, added that they had gone to California to see their second son, Reinald, his wife, Jackie, and the two granddaughters. Reinald had concluded a two-year special course in periodentistry at the University of California, followed by a year of thesis writing and teaching before he was transferred to the Philippines. George says: "We spent a week in California and had a brief visit with Ed Farrand. We would have liked to be able to tour more and to see Harold Cake, Ray Fisher, Sam Lunden and Ed Chilcott."

A phone call from Helen and Class President **Ray St. Laurent** told of a short visit which Marion and George Chutter paid to them at their summer home in Vinalhaven, Maine, in September. The Saints met their guests at the ferry and took them home for a Maine lobster dinner as only the St. Laurents can prepare that delicacy.

Mexican reflections

John B. Mattson, 69 Sargent St., Winthrop, Mass. 02152, counsellor at law and retired chief title examiner and deputy recorder of the Commonwealth of Massachusetts, comments most diplomatically on the picture of the '21 group in Mexico in the class notes appearing in the July/August, 1969, issue: "Hats off to *Technology Review,* which, in a reflective gesture, showed our '21 contingent as we would have seen ourselves in a mirror—a good-looking group!" We failed to give John credit for the photo, which, it should be explained, had been reversed from the way it was actually taken. John continues: "Elma and I have had a continuous round of friends and relatives visiting us from the United States and Europe. They and the summer are gone and the mad rush of fall is here, but I still have managed to get in some fishing in Boston harbor." We appreciate a number of color slides of Mexico which John has lent us to be copied, especially a series of scenes in Pátzcuaro and on the island of Janitzio, to replace a roll of film we somehow lost on the boat trip back from the island.

In Memoriam

Donald P. Severance, '38, Executive Vice President of the Alumni Association, has advised us of the death of Horace Sayford Ford. A memorial service was held in the Baptist Church in Brookline last September 26, with Jim Killian, '26, delivering the eulogy. "Uncle" Horace had been Bursar, Treasurer and Treasurer Emeritus of M.I.T. for 55 years. We all extend to his family and to the Institute our sincere sympathy. . . . On behalf of the Class, we also wish to express condolence to the families of two members of '21.

George Russell Steininger, of 502 South Fourth St., Geneva, Ill. 60134, died in 1965. A native of Reading, Pa., he was associated with us in the freshman year in Course I. At M.I.T., Russ was an associate night editor of *The Tech.* He had lived for many years in Chicago and Hubbard Woods, Ill., before moving to Geneva. He is survived by his wife.

Philip Meyer, of 572 Elm St., South Dartmouth, Mass. 02748, died on September 10, 1967. He was born in Kansas City, Mo., and had received the A.B. degree when he joined us in the junior year in Course X. A longtime resident of Nonquitt, Mass., he had moved to South Dartmouth about five years ago. He is survived by his wife.

Coming reunions

On the evening of June 14, 1970, we expect to have an informal class dinner prior to attending Homecoming 1970 (former Alumni Day) on campus the next day. And just 18 months from now, we will celebrate our one and only 50th anniversary, June 10 through 14, 1971, with several special observances. Reserve these dates so you and your wife can enjoy an unusual occasion. Meanwhile, please write to your secretaries.—**Carole A. Clarke,** Secretary, 608 Union Lane, Brielle, N.J. 08730; **Edwin T. Steffian,** Assistant Secretary, Steffian, Steffian and Bradley, Inc., 19 Temple Place, Boston, Mass. 02111; **Sumner Hayward,** Assistant Secretary, 224 Richards Road, Ridgewood, N.J. 07450

22

There is an old saying to the effect that it is not enough to do good; one must do it right away! This applied to your Secretary in writing Class Notes while trying to clear an overload schedule of meetings and just plain routine. Now that your President is back from Vienna and Budapest, we can quote from his Salzburg postcard picture of the Schloss. Madeline and **Parke Appel** tell of a perfect flight to Vienna with an exciting Hydrofoil trip to Budapest. They also drove by auto to several areas finally taking the boat overnight to Dubrovnik for an extended visit. From there they drove back to Salzburg and then on to Vienna for a short stay before returning to Boston. Parke wrote from a lovely spot, the Kobenzl, high up on the Gaisbergspitze on the outer limits of Salzburg: "Have been shopping along the Getreidrstrasse and are going to see the Salzburg Marionettes. We had an experience in Dubrovnik for the record. On the side of a mountain we were in 12 inches of rain in one hour with hailstones the size of walnuts and flooded streams washing out roads and pushing boulders at us."

We received a most welcome note from Chick Kane, '24, of Lincoln, Mass., including a photo of some classmates in Buenos Aires at their M.I.T. reunion during Christmas 1968. They included **Roberto J. Ottonello** and **Lucieno Preloran.** They and their wives were joined by Luis Igartua, '23. The photo appeared on page 132 of the December *Review.* Chick is still old fashioned enough to believe that the difficult Buffalo winter of 1937 is still hanging on.

Your Secretary's trip to Great Britain was pleasantly eventful. The most exciting part was driving on the left side of the road and one of the pleasant experiences was seeing *A Winter's Tale* at Stratford while we were staying at the Lygon Arms at Broadway in the Cotswolds.

Ronald G. MacDonald is editing the third volume set of *Pulp and Paper Manufacturer* being published by McGraw-Hill Book Co. Two volumes are being distributed in 1969 and Volume III in early 1970. These are the principal textbooks used by the pulp and paper industry throughout the world. Ron is also editor of the *Southern Pulp and Paper Manufacturer,* a trade magazine published in Atlanta, Georgia. . . . **Martha Munzer** has published this spring *Valley of Vision—the TVA Years* (Knopf). She has also developed high school programs on air pollution and its effects.

Mildred Allen is serving as secretary of the Mt. Holyoke College chapter of Sigma Xi. With Irving J. Saxl as collaborator, she published two papers in the May 1969 issue of the *Journal of Applied Physics* on the effect of tension on the torsional stiffness of a wire. . . . **Robert Prescott** is currently Chairman of the Board of J. L. Prescott Co. This company was started by his great-grandfather in 1870 in North Berwick, Maine. The President of the company and chief executive officer is Amos Neal Prescott, Jr., his nephew who is the son of Amos N. Prescott, M.I.T. Class of '19. . . . The United States Chamber of Commerce has listed a report by **Richard M. Rush** of Winchester, Mass. "Parameter of the Calculation of Osmostic and Activity Coefficients and Tables of Two Electrolytes at 25°C."

The September issue of *The Up-Look* has published a full copy of the "95 Theses" which **William B. Elmer** wrote and tacked to the door of the Unitarian-Universalist Association, 25 Beacon Street in Boston, outlining an approach to the foundation of a social-religious society for today's world. They state that this is an ambitious study and would serve as the basis for long and fruitful

discussions. It is noted but little known that Bill Elmer's role in developing the docking light for the Gemini and Apollo programs was extremely important. His final design of specular aluminum, spun and shaped by electro-forming was so efficient it could be seen by the astronauts at 50 miles. Bill also computed the construction and design of a 2 x 2" reflector that would be so positioned in a tiny flash tube that it would completely fill a 3-inch square on the moon with light for colored photographs. He is presently working on a book *Optics for Reflector Design.* Elmer has about fifty patents on electrical equipment, a number of them on heat control switches.

Since a heart attack about four years ago, he limits himself somewhat in hours of work but spends much time at his 135-acre, 200-year-old farm with colonial farmhouse near Manchester, N.H.

Oscar Horovitz has received a most interesting letter from our classmate **Chang Tsu Chien** with a new address—37-2 Lane 260, Kuangfu, South Road, Taipei, Taiwan, China. His letter follows: "It is opportune for me to report to the Alumni News the recent changes of my activities, as the last time my name appeared in the class information in *Technology Review* was in issue late in the year 1966. Having served the Chinese government for the last twenty years in various capacities equivalent to a vice-minister, and during the last four to five years sitting in cabinet meetings, I have been transferred to a semi-retirement status since January 1969.

"Though I am somewhat disappointed for not getting a cabinet post assignment after having served twelve years as the vice chairman of the Foreign Exchange and Trade Commission, a very important and powerful agency for an economically developing country, I am yet pleased to report that K. K. Choong, II, M.S., Sc.D. 1938 and 1940, was recently appointed as the Minister of Education, the first cabinet post held by an M.I.T. alumnus in China. My current position is the Chairman of Mobil China Allied Chemical Industries, Ltd. a Sino-American joint enterprise with 30 per cent Chinese government interest and 35 per cent each by the private investment of two American companies. It manufactures urea and ammonia sold to the government at a comfortable margin of profit and using mainly natural gas produced by a government enterprise. As all of my children, two sons and four daughters are married and living in the States, I have ample reasons to visit U.S.A. Certainly I wish to come to the 50th Anniversary Class Reunion of 1972." We hope to see Oscar and Mary Horovitz when they drive through Buffalo early this winter.

Among the new addresses received: William I. Horlick, Brookline, Mass.; Robert W. LeMare, Charleston, S.C. and Professor Edmund D. Ayers, Tucson, Ariz. We hope to hear more from classmates during the next few weeks on trips to attend meetings in Washington and Miami. Please keep the letters coming to sunny, old Buffalo.—**Whitworth Ferguson,** Secretary, 333 Ellicott Street, Buffalo, N.Y. 14203; **Oscar Horovitz,** Assistant Secretary, 45 Gerard Street, Boston, Mass. 02119

23

From John W. Beretta of San Antonio we learn from a clipping from the *Wilmington* (Delaware) *Evening Journal* that **Henry B. du Pont** of Greenville has been honored by having the new middle school near Yorklyn named after him. Henry served 40 years as a member and 30 years as president of the Alexis I. du Pont School District in that state. After being elected president in 1939, this district pioneered several new educational techniques, including one of the first sequential mathematics programs in the country, beginning with kindergarten and extending through the 12th grade. He retired in 1963 as a vice president and member of the executive committee of the du Pont Co. where he is still a member of the board of directors and the finance committee. After graduating from Yale University in 1920 he graduated with our class in 1923, receiving a degree of bachelor of science.

Now from *The Magazine of Cambridge* (Massachusetts) we see an announcement that **David W. Skinner,** vice president and general manager of the Polaroid Corp., has been promoted to vice chairman of the board of directors and vice president of that corporation. Congratulations to you two notable representatives of our Class!

Our sympathy is directed to ex-Secretary/Treasurer **Forest Lang** on the occasion of the passing of his wife, Ester, on October 18, 1969. Ester had been hospitalized for nearly six months. She was active in D.A.R. in New Hampshire and was a direct descendant of John and Priscilla Alden of our Pilgrim forebares.

Via the M.I.T. Alumni Fund we have the following tidbits of information. **D. G. Brinton Thompson** is Professor of History Emeritus at Trinity College, Hartford, Conn., and is listed in *Who's Who in America.* . . . **Gerald A. Fitzgerald** retired December 31, 1969 and expects to return to consulting on physical distribution of grocery products. . . . **Herman B. Swett** is just plain retired. . . . Two address changes have reached our attention but thank goodness, no deaths. The changes are: **Charles E. Monan, Jr.,** 14 Concord Ave., Cambride, Mass. 02138 and **Howard V. Shipley,** East Ave., RR 1, West Hill, Ontario, Canada. Please help fill this column!—**Thomas E. Rounds,** Secretary, 4 Deer Hill Dr., Danbury, Conn. 06810

24

I suppose you saw that spread in *Life* of all our governors at the Governors' Conference. They were grinning happily at the bikini-clad young lady strolling by in front of them. And did you spot Governor **Luis Ferré** in the back row? The photo wasn't quite as clear as it might have been, but it looked as though Luis's grin was almost as broad as Nelson Rockeller's. . . . **Mike Amezaga**'s retirement is now fact. He and Hortensia have left Chicago and are now settled in at 222 East 80th Street, New York. "We are trying to adjust to Manhattan," says Mike. Any pair that could adjust from pre-Castro Cuba to Chicago can certainly do that.

Nostalgic note: Away back in 1922, on May 20 to be exact, the Cosmopolitan Club held a luncheon meeting in Walker's North Hall. The business of the day was the election of officers for the ensuing year, but there was also a stellar program of entertainment—piano selections by L. A. Ferré and M. F. Amezaga.

People are already thinking about our 50-Year reunion. **Paul Cardinal** says the sentiment is definitely against returning to Bald Peak and, as reunion chairman, he will welcome any and all suggestions. It should be a spot reasonably near Cambridge, since we shall be honored guests on the platform at commencement (Friday) and again at the Alumni Day luncheon (Monday). **Jack Hennessy** is also getting going with the major task of raising our 50-year gift. On September 30 he had Ed Moll and Paul Cardinal for lunch in New York to go into details with Ken Brock, '48, and Jeff Ingram, '58, of the Alumni Fund. Since reunion gifts are five-year affairs and since "futures" (such as bequests) are an important part, an early start is essential. By the way, while we're on the subject, you no doubt noticed in the 1969 Annual Report of the Alumni Fund that '24 set a new record for 45-year reunion classes, $63,440. And this was accomplished with only 47 per cent of our active class roll contributing.

After 42 years with Ebasco and an associated company, **Albert S. Anderson** retired at the end of June. Andy is a longtime enthusiast of sailing and photography. Since coming north from New Orleans (that "associated company" was New Orleans Public Service), the Andersons have lived in Larchmont, N.Y., where Andy and his son Anton were three-time first place winners in the Long Island Yacht Racing Association competition. According to the Ebasco house organ: "He plans to spend his leisure time sail boating at the Larchmont Yacht Club, rose gardening, and pursuing his interest in photography." The activities are no doubt correct, but the locale is not. Andy says: "Looking for a place near salt water between New Haven and Cape Cod for $35,000 or less." So if you know a likely spot that fills the bill, write him at: 214 Rocking Stone Ave., Larchmont, N.Y.

Although he retired from the New York City Board of Water Supply ten years

ago, **Walt Gress** is still retained as a special consultant, "drafting contracts and specifications for some engineering problems that should have been resolved shortly after my retirement."

Walt was pleasantly surprised recently when he was notified that on January 1 of this year he would attain the status of a life member of the American Society of Civil Engineers. Not certain just what this lofty situation signifies except for one thing: "In this privileged status you will retain all membership benefits, but with exemption from further payment of annual dues." Walt says the end of that quote is what pleases him most.

An honor of a different sort came to **J. Earl Frazier** last spring. He received an award with the impressive title "the annual Dr. Albert Victor Bleininger Memorial Award" of the Pittsburgh Section of the American Ceramic Society, "exemplifying distinguished achievement in the burgeoning field of ceramics." President of Frazier-Simplex, Inc., since 1945, Earl has 33 patents and inventions to his credit, and this year becomes president of the American Ceramics Society. He received his master's in chemical engineering with us. . . . And still the honors come. **Jimmy Doolittle**'s latest is the U.S.A.F. Exceptional Service Award "for exceptionally meritorious public service as Vice Chairman of the Aerospace Corporation Board of Trustees and Chairman of its Executive Committee which reflects great credit upon himself and earns him the sincere gratitude of the United States Air Force."

On September 17 **Fletcher G. Hammer** died in Birmingham, Ala. As an undergraduate Jack was probably one of the best known members of the Class. He seemed to be active in almost everything, from Institute Committee all the way down to that hotbed of politics, the *Technique* Electoral Committee. He was a member of Kappa Sigma and such honorary societies as Beaver and Osiris. At his retirement from Southern Services a few years ago he held the post of systems planning engineer, and he seems to have retained his interest in varied outside activities. A member of the Canterbury United Methodist Church, he was also a founder of the Birmingham Astronomy Club, and a member of the Alabama Mineral and Lapidary Society. Jack is survived by his widow and two married daughters. To them goes the sympathy of the entire Class.

John D. Fitch, '24, International Executive Service Corps volunteer tells it like it is to Colombian engineers. Samel Ingenieros, Colombian engineering consultant firm, requested an I.E.S.C. volunteer to assist them in feasibility studies, and in the planning and design work for various electrical projects. In response, alumnus John Fitch, 44 years an electrical engineer and consultant, undertook the assignment.

One further death has just come to our attention. **Charles E. Lanyon** who was a graduate student in chemical engineering, and received his S.M. with us died last February in Troy, N.Y., his home for many years.

When these notes reach you we will have embarked on another year. According to *The Old Farmer's Alamanac* it will start with a rugged winter here in the north. Whether you're sitting it out in sunny climes, or whether you're staying put and proving you can still take snow and ice and soaring oil bills, may it be the start of a good year for you. And every now and then do take a moment to tell your Secretary (and through him the rest of the Class), how you're using that time you've been waiting all these years to call your own.—**Henry B. Kane,** Secretary, Box 177, Lincoln Center, Mass. 01773

25

There are many advantages of having a part-time job at M.I.T., but there are disadvantages as well; a few weeks ago being absent meant that I missed seeing **Roger Ward** who stopped by to say hello. He left the message that he is preparing to take a trip around the world by freighter and in the next few months we will probably have messages reaching us from many unknown spots.

Several notes have reached your secretary by the way of the Alumni Fund office. **Arthur K. Sun** writes that he is most anxious to obtain a 1925 year book. He lost his during the war in China. If any one reading this column has a spare copy, please get in touch with Arthur at 170 Pinewood Road, Hartsdale, N.Y. 10530. . . . **Charles Cooper** writes that he is still enjoying his retirement in the small town of Northfield, Mass.—population 2,500. He spends a couple of months each year consulting and a good deal of time working on town affairs.

Theodore (Ted) **Butler** writes that he retired on September 1, 1967 from the Massachusetts Electric Company and other New England Electric System subsidiaries. He has a son now a senior at Middlebury College in Vermont, and keeps busy with sailing, skiing, Carribean cruises, and "an old house," along with garden club, church, etc. He is planning to attend the 45th reunion in 1970; and during the next few months we will be hearing much about this. Put it on your calendar and plan to attend! . . . **Lynn Wetherill** has now retired from the General Electric Company. Among other things which keep him busy are his chairmanships of the Pittsfield Road Reconstruction Commission, and of the Massachusetts Board of Registration of Professional Engineers and of Land Surveyors.

There is one death to report, that of **Howard S. Allen** of Short Falls, N.H. on July 8, 1969.—**F. L. Foster,** Room 4-144, M.I.T., Cambridge, Mass. 02139

26

About a month ago the hurricane warnings went up here as a wild storm swept up the coast. We battened down, stowed all the terrace furniture, ash trays, bird baths and other flyable objects. At the height of the storm we looked out and a two master that appeared to be a Cheasapeake Bay Bugeye was going by under weak power with one man at the wheel and another standing forward, in street clothes, as though waiting for a bus on Fifth Ave., getting drenched. We expected they would head into Pigeon Cove Harbor but they continued North then turned back, passed the nun buoy on the wrong side, went right over the sunken rock and miraculously made it into the harbor. Meanwhile the hurricane went out to sea. Last week a man, wife and son were not so fortunate coming out of Rockport harbor in a 25-foot fiberglass sloop. The wind had been blowing when they made harbor the day before and they carried a double reef in their mainsail—no longer necessary in the lighter air. The sea was still rough from the day before. As they came out of the harbor (still reefed) and tried to come about they found themselves in irons and unable to sail as they approached the rocks—which they hit, casting all overboard. There was daring rescue work and the man and his son were saved; but when thrown overboard the wife was injured and had drowned before the rescuers pulled her out. I have always painted a picture for you of the beauties of our sea but it also has its cruel side if you are not prepared to deal with it—and sometimes if you are. Today is an in-between day. Overcast sky, rough sea, twenty mile an hour breeze—sufficient for the gulls to glide with only an occasional flip of their wings. One lone sail boat is heading out, probably toward their winter mooring in Glocester.

But what about news? Here's an honor recently bestowed upon classmate **George J. Taylor,** of Point Pleasant, N.J. "George J. Taylor . . . consultant for Day-Bright Lighting Company, today received the Distinguished Service Award of the Illuminating Engineering Society at a luncheon held in conjunction with the National Technical Conference in Boston, Mass. Mr. Taylor is a Fellow and past President of I.E.S., and is a Fellow also of the Institute of Electrical and Electronic Engineers. Prior to his retirement in 1964, George Taylor was Vice President for Marketing Research and Development of Day-Bright Lighting Division, Emerson Electric Company, St. Louis, Mo."

Don Cunningham gives us one of the back-of-the-envelope tidbits. "I retired August 1 from the Hersey-Sparling Meter Co. of which I was Vice President-Manufacturing, my second job after leaving Tech. I have almost finished my 40th year. I am lecturing in Graduate School of Northeastern University." And good old **Ted Faithfull** has also come across as follows. "Still actively practising patent law, specializing in litigation and opinion work. Quite a number of my partners are M.I.T. men, namely John Hoxie, '25, William F. Sonnekalb, Jr., '25, Richard Whiting, '26, the prettiest gal in the Tech show, Cyrus S. Hapgood, '33, Stanley L. Amberg, '60 and James E. Ryder, '49. I have seen "Bean" Lambert, '26, and his lovely wife recently and hope to see Andy Kellogg, '24.

Your Secretary has now been retired for a week and a half and is having to make this issue a little shorter than usual for lack of time. We have always chuckled upon hearing a retiree say how busy he is—and now start handing out the same line. It may be because we had allowed projects to accumulate but we will try to give you a reason after a month or two. Before signing off however we want to report that the sailboat we saw heading out to sea a few moments ago went barrelling off in the other direction like a bullet. Not believing our eyes we tried the binoculars and beheld that it was a catamaran so the speed was real. Meanwhile the sky has lifted a bit and some hardy fishermen have tied to the nun buoy; I have symptoms of sea sickness just watching them roll. Now that you find it is 1970, how about making a resolution to write your Class Secretary about *your* retirement activity—assuming you are not too busy to write! Meanwhile, cherrio until February.—**Geroge Warren Smith,** Secretary, Pigeon Cove, Mass. 01966

27

Donald Hawkes Spitzli, a well-known and greatly-liked and respected member of '27, died August 16 after suffering two strokes. His home was in Walpole, N.H. This is sad news for all who knew him. Don was born in Fitchburg, was president of the senior class at Springfield (Vt.) High School and entered M.I.T. freshman year. The broad scale of his interests was indicated by his membership in Tau Beta Pi, his rising to managing editor of *Technique* and serving three years on the fencing team; he earned both his S.B. and S.M. degrees in chemical engineering at Tech. On graduation, he joined Congoleum-Nairn Inc. at Kearney, N.J. and worked with them 19 years, becoming director of research. During this period, he and his wife Beatrice were raising a family of three sons in Summit, N.J. In 1951, he became director of research at Linen Thread Co. of Patterson, N.J. Don was a member of the American Institute of Chemical Engineers, the Association of Research Directors and other professional societies, and also the Chemists' Club of New York; several patents had been issued in his name; he took an active part in Boy Scout affairs, and was deeply interested in the M.I.T. Club of Northern New Jersey, of which he was president in 1957. The move from Summit to Walpole, N.H. in 1960 involved the winterizing of his summer home there, gave him a chance to do more work on his hobby of furniture restoration and reproductions, and Don then went to work for Air Reduction Chemical Co. on a consultant basis, studying the United States markets for synthetic fibers. Soon, Don's interest in a political career grew and he was elected to the New Hampshire Legislature in 1964.

At our 40th reunion, Don and Bea had much of interest to tell about the melding of an engineering and a political career. At this time, Don was chairman of the Committee on Judiciary of the New Hampshire House, a job always previously held by a lawyer. About this time, Don explained his philosophy on this subject in a letter to the president of the Chemists' Club: "The technical man need have no fear of being involved in politics. It is not the porportion of technical matters which can use his experience but rather good sense and ability to analyze a situation. Further if one has some administrative sense he can lead a committee efficiently. Even further, if he has a little of the 'ham' in him he can be effective on the floor. I would hope that some engineers may feel the urge to run for their legislatures. They are needed and will find it rewarding in accomplishments." (See photo p. 118.)

At The Franklin Institute's Medal Day ceremonies in Philadelphia last October, Professor **Harold E. Edgerton** was honored with the award of the Albert A. Michelson Medal for his outstanding contribution to the science of optics relating to the development of equipment to photograph shock waves, nuclear phenomena, and underwater subjects, and for his development of equipment to explore ocean depths by sonar. In 1941, The Franklin Institute had previously honored Professor Edgerton by awarding him the Howard N. Potts Medal for his development of the high-speed motion picture camera and the associated development of stroboscopic lighting.

Percy Richardson, who retired from du Pont in 1966, had been dividing his time among California, New Hampshire and Delaware. Recently, he reported an unexpected call at his Venice, Fla. cooperative apartment from **Jim Snediker.** Jim, who is an AT&T retiree, to the best of our knowledge, is living in Waldwick, N.J. . . . **Glenn Jackson** has gone to Santiago, Chile, on another assignment for the International Executive Service Corps. He will be consulting for a new textile dye and print plant and will be back by Christmas. Betty is staying with her interesting job at the Nashua Public Library. . . . **Otmar Praznik,** who reported an address in Baltimore last spring, is now at Apt. 7D, 200 NE 12th Ave., Hollandale, Fla.

Percy Lovett, a partner of the Engineering Service Co. of Halifax, Nova Scotia, has received an honorary doctor of engineering—honoris causa—from Nova Scotia Technical College in Halifax. . . . **Hilda Young** spent the month of October sailing the Aegean on the ketch *Velila,* then returned to her home in Bexby, Ohio.

D. H. Spitzli, '27

J. W. Gaffney, '28

Bill Erwin has moved his retirement site from Carlisle, Mass. to 123 South Channel Haven Drive, Wilmington, N.C., where he and his wife, Grace, are finding the area much to their liking. He is a member of the Cape Fear Power Squadron and currently is outfitting a 38-foot cabin boat for intracoastal waterway cruising. Bill is always most cordial about wanting to see old friends and classmates at his home. . . . First returns are in from **Jim Castner** after seven months of retirement of du Pont. "Retirement is wonderful," he says. "First summer at Kennebunkport without flyin up Friday and back Sunday."—**J. S. Harris,** Secretary, Box 654 Masons Island, Mystic, Conn. 06355

28

Here we are sitting down to prepare Class Notes for January 1970 and the first item on the pile refers to an event way back in June 1969! My apologies, gentlemen! Time just seems to slip by! On June 15, our hard-working class president, **Jim Donovan,** and his gracious lady, Frannie, held a cocktail party for local classmates at their home in Cambridge, Mass. It was a most happy occasion! My memory tells me the following were in attendance but I hope I will be forgiven any errors: Priscilla and Roger Haven, Ruth and Abe Woolf, Edythe and Dick Rubin, Dorothy and Herb Swartz, Elbridge and Mrs. Atwood, Carl Feldman, Gus and Mrs. Solomons, Iris and Phil Taylor, Sarah and Bill Hall, Ann and Will Tibbetts, and Walter Smith.

Some of the regret cards returned to Jim and Frannie contained snatches of news: **Katherine Hazen**: "Busy this time as we are off to Istanbul the next day!" . . . **Fred Lewis:** "A planned Father's Day family gathering at York, Maine on June 15 prevents me from accepting." . . . **Walter Ridley**: "Had a slight coronary; feeling fine." . . . **Slim Maeser:** "Alice's mother passed away and the funeral is Thursday." . . . **Ben Draper**: "Previous plans for celebrating our 40th wedding anniversary." . . . **Leslie Cutler**: "Just as busy since retiring as before."

Another set of brief news notes was gleaned from jottings on correspondence to the Institute: **Joe Gaffney**: "Have retired on July 31, 1968 after 40 years with Sears Roebuck and Co.; the last 18 of them as General Purchasing Agent." . . . **Al Daytz**: "In 1968 I gave a series of lectures on plastic design of steel buildings for enineers and building officials at California State College. These lectures were followed by a seminar given by Professor Beetle of Lehigh University and me. Hope to retire in December 1970." . . . **Ted Wood**: "Looking forward to retirement next year then to Tucson. Son Dan is in third year at Columbia College of Physicians and Surgeons. Daughter Jane is a stewardess for American Airlines."

Howard Emerson says, "On January 1, 1968 I stepped down as department head, continuing as Professor of Industrial Engineering at the University of Tennessee. In May 1968 at a banquet of students and alumni, an annual award to an outstanding Industrial Engineering graduate was set up and named 'The Howard Emerson Award.' The first recipient was announced last week, Sydney Gilbreth, Tennessee 1951." . . . **Gerard MacGillivray**: "Am 'semi-retired' as of March 1; however, I still have not severed ties by any means." . . . **Leon Gaucher**: "Retiring August 1 after 41 good years with Texaco. Planning to stay where we are now with some traveling sun-wise in the winters. May do some writing and lecturing on 'Energy Sources.' " . . . **Albert Briggs:** "Still having difficulty getting accustomed to retirement. Looking forward to 45th Reunion."

Bill Hurst is in print again. This time he is the author of a highly technical article in the *Oil and Gas Journal* for July 14, 1969, "The Radius-of-Drainage Formula." He appears to have lost none of his facility to speak in the language of mathematics. Bill is a petroelum reservoir engineer and operates as a private consultant. . . . While on a quick trip to Nova Scotia last August with wife Clara and their oldest son, **Bill Archibald** wrote Jim Donovan a postcard expressing the hope to visit him in Boston. Please, Bill, next time may we have some details on your trip? . . . In another piece of correspondence to Jim, Trudy wrote that **Don Francis** had had a slight heart attack (early September 1968) but was now doing all right at the hospital. The attack occurred as they were heading out to dinner. In her final sentence Trudy says, "I spend quite a bit of time at the hospital just so I do not have to do housework."

Every now and then something happens to delight the heart of a class secretary. This time it is a really long letter (again to Jim) from **George Bernat.** The letter consists of four pages of tightly written script and will have to be given in installments. Nevertheless, it is so interesting that we intend to share all of it with you. Perhaps it will stimulate more of you to write. Following is part one: "Thanks for your nice letter of August 22. I always marvel at how much you do. Judging by your new stationery I would gather that you have expanded your business considerably, so you must have developed a good organization which enables you to devote so much time to our class affairs and personal contacts. At our 40th reunion you mentioned something to the effect that most of us seemed 'dead.' I think you are right—at least in my case. Outside of travelling for two or three months I would say that I lead a rather idle life. However, as you know, things have happened which sort of squelched any ambition I might have had.

"I have never written a letter for the class news but will give you a short resume of the trips Ruth and I have made in the last few years. 1964—A trip out west where we visited Yellowstone, Teton, San Francisco, Las Vegas, and parts of Arizona and a six-week cruise to the South Pacific. We found everything very interesting, but being on a ship so long becomes boring toward the end. The stops at Tahiti, New Zealand, Australia, New Caledonia, Samoa, Fiji, etc. were interesting and gave us a good idea of the people in each country and the various islands. 1965—We spent the summer in Westport, Conn. with our two sons. Unfortunately, we can't look back with pleasure on that summer because on September 5 our younger son, Robert, died in an automobile accident in Yankton, South Dakota on his way back to law school at the University of Texas.

"In 1966 we toured Panama and South America for about seven weeks. Here again we got a very good idea of the various countries and the people. We saw the Inca ruins at Macchu Picchu and Cuzco and in general got a good idea of how the Indians live and the difficulties in living at such high altitudes. La Paz is 13,000 ft. above sea level and the airport there is 15,000 ft. above sea level. Some of our group had to take oxygen periodically and I am told that one's life span at these altitudes is usually less than 50 years." (More to come.)—**Walter J. Smith,** Secretary, 209 Waverly St., Arlington, Mass. 02174

29

I deeply regret to inform you that, **J. Ernest Whalen,** of 231 Pleasant St., Arlington, Mass., passed away on September 8, 1969 at the age of 63 after a short illness. Employed for many years as an architectural engineer by Stone and Webster of Boston, he was scheduled to retire within the year. He leaves his wife, Katherine, who resides at the address above.

A letter comes from **Herman J. Behrens** who says: "I have just changed the beneficiary of the $1,000 life insurance policy which we took upon graduation to M.I.T. and upon maturity the Institute will receive its face value. This will have to be the extent of my class gift and my contribution to the current Alumni Fund." Herman, who has been associated with Edison of New York ever since graduation, is now a senior engineer in the System Engineering Department. His work involves him in future capacity addition, transmission and economic planning. He would have loved to be with us at Wianno

except that his wife, Ruth, had an accidental fall in 1965 and broke her right hip; she uses a cane but walks with difficulty. He has three children, two girls, both married, one living in Philadelphia and the other in Houston, Texas. The third child is a boy and batchelor who lives at home.

Frank O. Pierson who attended the 40th reunion with his wife Florence is the treasurer and controller of his family's nursery business in Cromwell, Conn. He states in his report that during the 20 years following graduation he was an industrial engineer with Atlantic Richfield, du Pont, General Motors and International Paper. Later he became New England Manager of E. McIntyre Associates, doing consulting work for a variety of firms engaged in the manufacture of metal products in their fabrications by punch press, bending and assembly painting.

Just as he was about to retire, he was called upon to take active part in the management of a family nursery business which was going through a reorganization phase. He then faced a new challenge, a new job in an entirely new field, growing flowers and plants and shipping them all over the country. He has one child and two grandchildren. Among his hobbies, he lists golf, woodworking, oil painting, photography, scuba diving and travel. Unfortunately *no gardening.*

William W. Saunders, among the first Course XVII graduates along with Len Peskin, Robert Pride, Harold Pease and your Secretary, has retired and lives in Governor's Island, Laconia, N.H., with his wife Elinor. Bill went to New York after graduation and landed a job on the construction project of the Waldorf-Astoria Hotel which lasted for two years. He returned to his hometown of Baltimore, and continued to operate in the field of construction for two more years until the depression, which hit the construction field hardest, caught up with him. Then he started his own manufacturing business which he operated successfully until 1968, at which time he sold his business and retired. He has two children and five grandchildren. Among his hobbies, he lists competition badminton (until recently), fishing, golf and sailing. He spends six months in New Hampshire and six months in Naples, Fla., each year.

Gordon R. Williams writes that he is an associate of and chief hydrologist in the firm Tibbetts, Abbott, McCarthy and Stratton, Consulting Engineers and Architects, New York. He states that he has worked on water resources development in 18 foreign countries located on every continent except Antarctica. "After 17 years in the Federal engineering bureau and 23 years in consulting, I might now qualify as a job counselor. My preference is still for consulting as it offers a broader outlook on the world, unfettered by either legal constraints or intellectual fads." His wife's name is Alice and they have two children. He lists antiques, gardening and golf among his hobbies.

Nicolaus Harms writes that because of pressing business travel engagements he was unable to attend the 40th reunion. He is presently vice president of Symington Wayne International Co. Ltd., subsidiary of Dresser Industries, Inc., Dallas Texas. After graduation, he returned to his permanent home in Rio de Janeiro and joined the Rio's Tramways Light and Power Company. His first assignment was as assistant to the resident engineer on a 5 million dollar construction project. Upon completion of this task he was given the responsibility of establishing a Brazilian subsidiary of the Wayne Pump Co., Fort Wayne, Ind. and became the subsidiary's managing director.

In 1959 he was transferred to New York to establish the parent company's foreign division. He became President of Symington Wayne Overseas, Ltd., and Symington Wayne International, two subsidiaries doing business in 82 foreign countries. In 1968 Symington Wayne merged with Dresser Industries, Inc. of Dallas Texas. He is looking forward to retirement in less than four years when he will live in Chapel Hill, N.C., with his wife Audrey and be close to their only child, an expectant parent.

John J. Fahey, better known as Jim, lives on Georgetown Road, Boxford, Mass., with his wife Marie. Jim is the President and a director of Haverhill Gas Company. His first job, after graduation was with Virginia Electric and Power Co., Norfolk, Va. Excepting three years in the army as captain in charge of public utility problems in Europe, he spent about 20 years in Virginia with various utility companies. He went to Haverhill in 1951 as Vice President and General Manager and worked his way to the top position as President and a member of the Board of Directors. Among his hobbies are golf, skating, bridge and gardening.

James B. Magenis states in his biographical notes that after graduation Uncle Sam's Navy offered him a free course in flying. He accepted the offer and won his wings in June, 1930. His first job was with the Massachusetts Industrial Commission as investigator into the woolen and worsted industries in the state. Then through the depression, like many other '29ers, he had a variety of odd jobs such as plant engineer, brokerage office clerk, his own oil business, etc. In 1937, P.A.A. came along and offered him a steady job at $150 per month which he took and got married. In 1968, he ended his flying career because of age limitations and he is now teaching math at Eastern Military Academy. Jim and his wife, Marjorie, were at Wianno. They have three children and list one and a half grandchildren. By the time these notes are in print, the number of grandchildren most likely will have become two.

Thomas H. Speller and his wife Helen also were present at the 40th reunion and having the time of their lives. Tom currently is the President of General Electro Mechanical Corp., of Buffalo, N.Y. He says, "Like the 'one man dog,' I seemed to have turned out to be a one job man." Except for the first five years following graduation spent with Curtis-Right, Tom has been involved in management roles at GEMCOR. He says, "Given enough entrepreneural instinct to feel secure in one's own enterprise, and some good fortune in decisions made without benefit of adequate research, it is possible to fashion precisely the environment that suites one best. In short, to be a big frog in a small pond." They have four children and three grandchildren. Among hobbies, he lists, golf, fishing, bridge and travel.

Sam Shaffer, who married his wife Sybil in 1927 while an undergraduate, came all the way from California to be at the reunion. At present, Sam is the treasurer of the Macy Co., of California, a chain of department stores. After graduation Sam joined G.E. as a trainee. Then came the depression and he moved to New York joining R. H. Macy as inventory supervisor. He became assistant controller in 1948. The same year, he was appointed controller of the Macy Company in California and became its treasurer in 1968. He expects to retire in another year. The Shaffers have two children and two grandchildren.

I would appreciate hearing from some of our classmates who may have something good to report. Best of health to you all. —**Karnig S. Dinjian,** Secretary, 32 Oldham Rd., Arlington, Mass. 02174

30

As of this writing **Dick Wilson**'s annual letter to the members of the Class has arrived, reminding us that the 40th reunion will be held at the Wianno Club on June 12, 13 and 14. We hope you are planning to attend. Program details will be given in a later issue.

During the course of a recent visit to New York, **Mannie Birnbaum** stopped in to see me and we had a pleasant chat. Some years ago he sold his business to Unilever but he still does some related consulting work. He is also a member of the Board of Governors of the University of Guelph and has various other volunteer jobs. The Birnbaums have three sons: John, who works for MacLean-Hunter Publishing Co. in Toronto; Robert, who studied medicine and is interning at the University of Alberta Hospital; and Peter, who is studying physical anthropology at the University of Toronto. Mannie says he is planning to attend the 40th.

Charlie Smith has retired as Lieutenant Colonel U.S.A.R. and is working part-time for a discount chain in Framingham, Mass. He is a member of the Retired Officers' Association. He says he intends to retire permanently in Florida very soon and would be interested in hearing from any classmates living there. The Smiths have two married daughters: Kathleen LaCroix, who lives in Millis, Mass. and has two children; and Charlene Mallette,

who lives in Brooklyn and works for U.S. Steel in New York. . . . **Walter Soroka** is Professor of Acoustical Sciences in the Division of Applied Mechanics at the University of California in Berkeley. In addition to his teaching duties he does research in dynamics, mechanical vibrations, noise control and architectural acoustics. The Sorokas live in Lafayette, Calif., and have a daughter, Dorothy, who graduated from U.C. as a math major, and a son, Donald, who is a master mechanic in the communications equipment field.

Since leaving M.I.T. **Norman Smith** appears to have established a record for the number of companies that he has worked for. These include Foxboro Co., Manning Maxwell and Moore, Crosby Steam Gauge, Research Associate at M.I.T. (working under Dr. Draper on gyroscopic anti-aircraft gunsight), Fenwal Inc., Scaico Corp., American Meter Co., Leeds and Northrup, Philco Corp., J. E. Lonergan Co. and Boeing, where he is now located. He is presently working on fire safety requirements for the new Boeing 747 at Everett, Wash., and is responsible for propulsion test requirements for the first five flight test 747 airplanes. He is also a member of ISA and ASME, National Chairman of the B-40 Pressure Gauge Standard Revision Committee (ASME) and has had 38 patents issued to him. The Smiths have three children: William, who is an aeronautical engineer with the Navy Department in Philadelphia; Beverly, who is married, has two children and is a computer programmer; and Norman Jr., who is in the navy on the aircraft carrier Ranger. Norman says he recently had a "mini" class reunion with **John Parmakian** who is with the Department of Interior's Bureau of Reclamation in Denver.

Changes of address: Charl D. Cillie, 207 Snead Fairway, Portsmouth, Va. 23701; Byron L. MacKusick, 280 Ridge, Crystal Lake, Ill. 60014; Edward L. Mears, P.O. Box 182, Center Harbor, N.H. 03226; John J. Molloy, 39 Pine St., Medfield, Mass. 02052; Philip J. Riley, 21 Bedford Court, Echo Hill, Amherst, Mass. 01002; Hymen Shrager, 17 Lakeview Gardens, Natick, Mass. 01760.—**Gordon K. Lister,** Secretary, 530 Fifth Avenue, New York, N.Y. 10036

32

William H. Barker writes that while on a vacation trip with his wife last February and March to Portugal, Madeira and the Canary Islands he acquired a goatee. He says this confuses his creditors and enables him to sign autographs as Burl Ives. Bill is still functioning as an M.I.T. educational counselor. . . . **Gaynor Langsdorf,** Sloan Fellow, writes that during the past year he was President of the Bay Area U.S.O. The four U.S.O. Clubs in the San Francisco area served over one million service men in this period. . . . **Byron E. James,** Course IX, has been named chairman and chief executive officer of McQuay, Inc., Minneapolis which manufactures air conditioning, heating and refrigeration equipment, he was formerly president of the firm. . . . **Glen W. Poorman,** Course X-A, is reported in the August issue of *Chemical and Engineering News* to be retiring from the presidency of Esso International Inc.

Francis Horton, Course X, has been appointed chief engineer of the engineering department of Texaco Inc., Houston. Francis joined Texaco in 1936 as a senior engineer in the refining department in New York. In 1954 he was named assistant chief engineer of the engineering department. His duties have included a wide variety of process design work for Texaco's refining, petrochemical, sales and other operating departments. . . . **Robert K. Mueller,** Course XVI, has written in the November 1968 issue of the *Science Journal* of the "managementality gap" which exists when the managers and the specialists in management science do not share the same opinion on management practices. He concludes that these two groups must reach an understanding of the "state of the art" of management theory and the behavioral framework of organization.

Edward Dwyer, Course VI-A, was included among those who were thanked for having worked diligently over the years and who were credited with planning and organizing the 16th National Conference of the Armed Forces Management Association. This is a national organization of 4,000 members and 39 chapters which has as its purpose the improvement of management throughout the Department of Defense.

John F. Crowther, Course X, has an article in the September/October 1969 *Harvard Business Review* "Peril Point Acquisition Prices" in which he offers a statistical technique to guard an acquiring company against the temptation of paying too much for an acquisition. John has recently been working on acquisition studies for the Chemetron Corporation and from 1965 to 1968 was General Manager of Chemetron's Northwest Chemical Co. in Detroit.

Julius Brody, Course VII, has two articles, one in the August and one in the October issues of *Food Engineering* on how to save the U.S. fishery industry. He presents a startling disclosure of how far the United States industry lags behind other countries—**Elwood W. Schafer,** Secretary, Rm. 13-2145, M.I.T., Cambridge, Mass. 02139; **James Harper,** Assistant Secretary, 2700 So. Grant St., Arlington, Va. 22202.

33

For living right, as we hear, we have an old Course II, mechanical engineer as a lead-off feature this time. Not too long ago, we had a press story about the retirement of **Charles** (Chuck) **MacMillan.** This Chuck duly acknowledges, but he wonders where we find this stuff. Well, sir, M.I.T. uses a clipping service and it is their job to pick up all news, all over, of M.I.T. men. When I first became Secretary of the Class, I made inquiry as to what do we do with the abandoned press clips, and was told that I had all the usual alternatives, or I could throw them out. It now appears that some fellows make the news and do not even know about it, so except for obvious cases, I will send clips to those indicated.

Now, to cap the climax, Chuck MacMillan came to the Class Officers' Conference unannounced, attended most of the events, plus the dinner and preparty. Then he and his lovely Helga came to New Hampshire to see me and my lovely. The pair were on their way to Hanover where son Frederick is enrolled at Tuck School. Fred might for one semester only, take some work at New York University in line with his business studies. Further, son Jim is a graduate of M.I.T. 1965, and Western Reserve (Cleveland) Medical School, 1969. Jim is an intern at the Denver General Hospital, and is headed for the practice of general surgery. It was more than apparent that Chuck and Helga were proud as all can be in telling about these two fine boys. I never knew, or had forgotten, that Chuck is a native of Denver.

We sure enjoyed having the MacMillans drop in. I had no idea that they were in town and I had to leave the conference early Friday for New York City, where I had business that could not be ignored. However, my St. Louis foreign office man, **Ellis Littmann,** acted for me, and tracked down all the 1933 participants. John Wiley, I saw personally and Ellis added Cal Mohr, who came later, Bill (William) Klee, of Warren Ohio, who was there when I was but well hidden from me. I am sorry indeed, Bill, as I sure wanted to see you. Also attending were the ever faithful, and capable Westy Westaway and, of course, Chuck MacMillan. John Longley expected to show up, but did not appear. We will cover John a little later, as I have heard from him. Ellis further reported that he saw Bill Barbour who had signed up for the Alumni Seminar, which followed immediately after the Officers event. Others registered for the seminar were Arra Steve Avakian, of aerospace fame, and Mr. and Mrs. **Edward Rohn,** I know but little of Edward Rohn, except that he is an aeronautical and astronautical man, from California. I do, however, hope to find out more and report on this character later as soon as I can get to sending him greetings and supplications.

The irrepressible **Cal Mohr** comes through with a lighter tone than usual but good, for sure. Cal, it seems, took a trip to Carlisle, Pa. to attend a symposium at the Eaton-Dikeman Co., makers of filter paper. After the meeting, the president of Eaton-Dikeman took Jean and Cal on a trip to Gettysburg. This chap is a member of the Gettysburg Roundtable, and these fellows are able to put on a guided tour second to none. Then they spent two days in and around Lancaster, I suspect both business and pleasure.

After Lancaster, they had a chance to see the old Cornwall Furnace, and the iron mining area. Cal reports that the Cornwall Furnace is remarkably well preserved.

We have a quickie from **Clare Farr,** of organ and ham radio fame, and that's for sure. Clare and his lovely were at the last Alumni (Homecoming) Day, and now comes a post card from Buena Park, Calif., wherever that is. They had visited the "ghost town" and communed with Sad-Eyed Joe, a seer, or so we hear. I quote: "The grandchild population in the Farr family tripled in August, jumping up from one to three." Clare does not say so, but he just might be out there seeing the new gradnchildren. Thanks for remembering us.

We now return to **John Longley,** who took the time to drop me a line (one and one-half pages), from some place in New York —Slingerlands! I looked it up. Sezzee, nothing important to report. Haw! I do wish that the fellows would write me, and allow me to decide what is important. It appears that John is enjoying a healthy retirement to the fullest. John, many a man wishes he could say that but can't because he does not know how to enjoy himself. This is it: a little golf, scores reflecting the time put into it and some swimming in the club pool. Upon retiring five years ago, John joined the local volunteer fire department as they needed men around town during the day. So, he now has learned how to lay hose, use and teach others to use oxygen masks, drive fire trucks, etc. They do have a fire occasionally, but make short work of them, luckily. Besides all the expected drills, John is also a member of the District Board of Fire Commissioners, which requires a different hat from the one used driving a fire engine.

John's Lillian also keeps things moving; she is a golfer, teaches art (she is a painter and sketcher of some note) and does a small amount of radio hamming. John has been a radio ham for 44 years; Lillian joins him, but with her own station. The home workshop seems to be what John does with the other hand. All this while at home in Slingerlands. But, the Longleys are not home much, as they own a 21-foot self-contained travel trailer, in which they take short trips often and have taken several long ones— one to California, later they visited the Carolinas extensively and last year toured the state of Maine. It seems that one can get to Maine without stopping at Exeter, or even passing it, but, it ain't easy. He promises to drive in here one of these days, so there. Winters, the Longleys become skiers, though John says that he now avoids the higher slopes.

While visiting Virginia several years ago, the Longleys went to a cocktail jamboree and, as he says: "We touched on most all subjects, as one will at these affairs, but did not go far enough, as it later came out that the host of the party was **Richard Shepp.**" Small world? So, for those who remember Dick Shepp, he lives in Kilmarnock, Va., on the banks of the Rapahannock. So, Dick, if you are a reader of these immortal lines, please fill us in on what John did not find out (via the next mail, preferably). Well, folks, that covers the Longleys, and in some detail for the very first time. I have heard a little of this verbally, but all that is wasted on me. My most sincere thanks, John, for all the swell details.

Several issues back, I mentioned **Julio Ulloa,** of Ecuador, an electrical engineer, and a visit to Julio's home by **Robert L. MacCormack.** Duly, I wrote brother Mac and lo and behold, I received a reply. Mac, you will never quite realize the satisfaction I get out of a reply such as yours. I really appreciate it. The trip to South America was to visit son, Bob, University of Pennsylvania, A.B. and Columbia, M.A., who is in the Peace Corps in Columbia, with an M.B.A. group, working with small business. Bob finds the work very interesting and is doubly happy therefore. "Went to Quito to visit Julio; had a wonderful reunion, with a perfect host." His second son, Kevin, went to Syracuse, A.B., and daughter Catherine, is now a sophomore at Boston University. The MacCormacks have been quite active in the M.I.T. host family work during the last ten years. I am not familiar with this phase of M.I.T. but would sure love to know more about it. Many thanks for your fine reply, Bob, and best to your lovely.

Here is one for the book, fellas. I have a fine, but uninformative note from Mrs. **Gerard Kincade,** bless her heart, in which she asks me for addresses of ten hot shot classmates. When I used the long adjective above, I meant only that she did not send any class news to me and when she got the addresses a few days later, I also received a request for news, from her, not Gerry. If anything comes of this romance, I will surely let y'all in on it. Just in passing, I am now encouraging the wives to write to me, as often as indicated. It is evident that the men won't write so how can I lose and I do love to hear from the gals.

Recently, it was my extreme pleasure to visit Cleveland, to attend an employment anniversary, the 50th of my dear old friend, Walter Bailey. It was my first chance to visit with what I call the new Warner and Swasey group, as well as the old that I knew so well so many years. So, while waiting for the New York City plane, I made several phone calls, the first to **John King,** CE (Course I), who is with Master Builders, Inc., of Cleveland, way out south on Lee road. It seems that he and Mary have just completed a round-the-world trip; a business trip he says, and it probably was as they made a rather limited number of stops; at Honolulu two days, Japan ten days, Hong Kong four days, Thailand four days, and Istanbul four days', this last stop to see if Robert College is still there. It is, and is doing fine. I still do not catch John's connection with this college.

The King family seems to be getting established in good order. Daughters Dianne and Katherine each have two grandchildren for John and Mary. Son, Bruce, attends Kent State (Ohio), where he is a senior. John is not too active, civically, but is chairman of the construction division of A.S.C.E. For the added information of all of us, I made inquiry as to just what Master Builders is. It turns out that they manufacture additives, or admixtures for concrete. I will ask John just what these admixtures are. He just might tell me.

The next phone call was to the home of **Ken Moslander,** reported earlier as having moved to Chagrin Falls, Ohio, 20-odd miles east of Cleveland. After considerable discussion with the telephone operators, it turned out that Ken lives in Bainbridge, next town south of Chagrin Falls, though the Falls is the post office location. Ken was not at home (11:00 a.m.) having gone to work, it seems. So, Esther and I gabbed 65 cents worth about many things. Less than a week later I received a fine letter from Ken, so I am combining the letter contents with Esther's contribution. All three Moslander children are college graduates—daughter Debbie went to Denison (my son's Alma Mater), while Nancy and Ken Jr. went to Wisconsin. Ken and Esther went to Madison for Ken Jr.'s graduation on the exact weekend of our Class 35th (he avers). Nancy has two children, and Ken Jr. has one, so Ken is a full fledged member of the grandpa club.

In his letter, on Weatherhead stationery, Ken states that he did get my last "pornographic" post card in July. I protest. I do not send cards of that kind, just suggestive, maybe. Ken, after retiring from Linde, could not stand the tedium of loafing, and got back into the rat race, though a much better rat race than before as he can commute by car to his work in 25 minutes (my estimate). He is general manager of the Weatherhead automotive division, and, to quote loosely, he "hasn't had so much fun in a 'possum's age." Haw! The various plants under his supervision are located in Ohio, and Indiana. He does not say how many. They manufacture air conditioning units, power steering, and brake components.

As soon as they get the new models (automobiles) into full production, the Moslanders are planning on a few weeks vacation in Barbados, where they spend many vacations, and love it. Well, some do, and some do not. Ken allows that, were it not for the kids and their kids, they might well consider retiring to the Islands, on a permanent basis. Well, folks, it takes all kinds, I expect. Ken, in conclusion, says that having missed the 35th, he is looking forward to the 40th, even if he has to come in a wheel chair. Many, many thanks, Ken and Esther, for the latest information on the Moslanders. Further, if and when I get to Cleveland again, I will surely look y'all up. The tone of Ken's letter, not to mention the text, suggests that the Moslanders are extremely happy in Cleveland. I can understand it easily. The pace is a bit

slower than New York or Detroit, and one has a chance to live right, if he so chooses.

We have a quick one; a card, from Vice President **Beaumert Whitton,** of the not so deep south, with suitable comments on the Interim letter. Beau complains about a dearth of news from the old Course XVII group and when he gets around to it, he intends to do something about it. That's great, Beau. I do not know how many slackers are involved, but I do know Gene Sullivan, Tom Galvin, and Ed Rowell, but cannot get anything out of them. Go ahead, Beau, and if you need clerical help, see my typing. Daphne and Beau are soon leaving for Kenya, not to shoot lions, but to see their number two daughter, who is spending the fall term there instead of at Duke: exchange, maybe? I quote, "Enjoyed your story on Dick Morse. Always knew that he had it." Thanks a million for being so thoughtful as to write me, Beau. It is heartening.

Here's one, unsolicited, from our very own **Bob Winters,** President of Brascan, Limited, which was, formerly, the Brazilian Light and Power Co. Ltd. Bob always writes an interesting letter, usually quotable in toto. However, we do not quote that way; only bits and pieces here and there. Here is a bit, for better or worse, "I am afraid you do not always get the full cooperation you deserve, partly because many folks are dilatory about writing, and partly, too, I presume many of our colleagues are too modest to publicize their substantial achievements." Now, what could be fairer than that? Bob sure thinks straight, and expresses himself well, for sure. Now, my good folks, I quoted that for a dang well good reason. I can't write nine, 20 double-spaced-page classics and an interim letter, unless I can cure dilatoriness and upgrade said modesty. Bob allows that his speechmaking, though not done away with entirely, is at a minimum, and then mostly to colleges and student groups. How does he get them off the picket line? I used to love to read and digest Bob's speeches, and have even quoted parts of them before now. I suggest that, with a little revision, any of them could be used over again, and not wasted in the file after that first delivery. He sent me a copy of a press release from *Who's Who in Canada,* complete with a fine photo and a rather complete story of his past and present including a long detailed list of his business and social connections. He has re-established his connections with a number of enterprises as a member of their boards, and has accepted a few new such invitations. This is by far the understatement of this year, as the list of these is three full inches deep, and in fine print. Through a reorganization, Bob has been made Chairman of the Board of Brascan, Ltd. This is all done using only one hand. The other hand is helping to establish, and is Chairman of the Canadian Association for Latin America, which is similar to the Council for Latin America in the United States.

In September he attended the International Industrial Conference in San Francisco, and this week, he will be in New York City, attending the meeting of the National Industrial Conference Board, of which he is a trustee. By golly, here is a bit of news, "My son, about a year ago, presented me with my first grandchild, and my daughter is now married and living in Toronto." Last I heard about Bob's son was that he was living out in western Ontario, in my old moose hunting country, way north of the Soo. I hope I am right, but danged if I will look it up.

My deepest and most sincere thanks, Bob. You are a joy. Leona and I send our very best to you and your lovely Eleanor.

We have a few items from the clip bureau; **Elmer C. Henderson, Jr.** (Slick, to you fellas) has been promoted to Executive Vice President of Sverdup and Parcel and Associates, Inc. This firm is one of the bigger combinations of engineers and architects, located in St. Louis, Mo. The promotion release appears to have been made near the end of July. Our most sincere congratulations, Slick. It could not happen to a nicer fellow, my friend, and with two more steps to go, please don't try to make them both at once, as I know you might try.

We have another about our own **Morris Cohen,** a two-page, double-spaced article, announcing that Morris is the president elect of the American Society for Metals. The two pages are devoted to Morris's *curriculum vitae,* in great and lengthy detail. (Golly, I must write Bob W., and tell him that he has given me a new word to flaunt around.) All the information in the release has been written here more than once and even though Morris rates all we can give him, we find the editors getting a bit stuffy about too much repetition. Morris's story is to be found at least once in one of the last nine issues of the *Review.* However, we wish to congratulate Morris on his impending new job. Gosh, Morris, do you remember that, when we both joined that outfit, it was called the Steel Treaters? Great stuff, Morris.

Now comes **John Rumsey,** who has also been promoted. He is now contract sales manager of Mechanical Handling Systems Division of A.C.C.O. Corp. of Detroit. John is active in the International Material Management Society, the Conveyor Equipment Manufacturers Assn., and the Engineering Society of Detroit. He is also president of the Bloomfield Township Library. Johnny is a Tau Beta, too. John, this item is almost four months old, and I submit that you colud have sent me the story long, long ago. How do you fit into the specifications set up above? Are you too modest to tell this story yourself, or are you the procrastinating type, or neither. OK, John, all kidding aside, we offer, for your approval, our most sincere congratulations, and best wishes and please drop us a line once in a while.

We have from the *University of California Review,* a reprint of an article, "Urban Unrest—Whose Problem Is It?", by **L. W.** (Bill) **Moore,** president of American Oil Co. and a most illustrious classmate. This might have been a speech, but no such designation is shown. We cannot possibly include very much of Bill's story, and this we regret, as when Bill talks he says something. He comes up with a small kernel of hard to beat fact, when he says: "Business must become involved as the ultimate source of jobs for Black Americans, as only it can ultimately supply these jobs. Business and industry also have the knowledge, skills, and technology that could be a powerful force in the solution of related urban problems, such as housing, transportation, and economic problems." Bill goes on to reiterate a statement that he made two years ago—that middle management must become further involved in the solution of some of our social ills, as it is closer to the problem than top management is, being all day, right on the firing line. Bill holds that these folks in middle management are the link between the man in the shop, and the man in the penthouse. He has discussed this feature before, and seems to be much nearer to the solution than he was last time out.

Bill tells us a short story about his own company and what they have done, in what he calls a small way. Someone in the ranks suggested that American publish a book, and distribute it, in the black community and elsewhere—a pictorial travel guide that would identify monuments throughout the country related to black achievement. Perhaps such a book would help black Americans identify with constructive and dignified roles, and encourage their emulation. It appears that the idea was sound and they went ahead with it with some research. They estimated the need to be about 100,000 books, with some misgivings that this number might be too high. After three years, three revisions, and numberless printings, with no sales publicity, they are still distributing 7,500 books a week. To quote Bill just a little, "Our little book didn't solve all the problems in the ghetto, but I think that it might well have stimulated in some little black children the desire to solve some of their own." This kind of a summation is a bit like translation from one language to another; something is always lost in the process. I am sure that Bill Moore would make it easy for any of you to get a copy of his article unabridged, if you write him at American Oil Co., Chicago, Ill. That was a good job, Bill, and we are all proud of you.

By Golly, right at the bottom of the clipping pile, I find **James E.** (Jim) **Turner**'s story as released by Textron. Jim, as some of us have known for some time, is now a group vice president of Textron, and now lives near Providence. Jim, until recently, had been vice president of Talon, which is now a division of Textron. Jim joined Talon in 1938, as an auditor, and was a director of that company. Talon is known internationally, as a man-

ufacturer of zippers, made from metal and nylon filaments. They also make thread, tapes, and other home sewing supplies, and miscellaneous industrial products. I can go about so far with Jim's new position, and no more as the release is all too brief. Perhaps Jim will give us more details later. However, Textron, with headquarters in Providence, is a multimarket company with 33 divisions. Its operations are in four basic groups, aerospace, consumer, industrial and metal product. That's it, and they cut me off right there. Whoa, I almost missed one item; Jim, as a group officer will supervise a number of Textron divisions. Jim has proven to be a popular, and surely hard working president, and class publicity is, for us at least, indicated. Trouble is, I will see Jim in late October in Cambridge, then I write up what he has to say for the magazine.

This time around we have only one Alumni Fund capsule; it's from **Forrest P. Dexter, Jr.,** of Cranford, N.J. He starts off: "Promoted to full professor May 1969." Where? Here is where Goodridge 25 comes into use. Goodridge has it that Forrest is in teaching science at Union Junior College. He spent the summer in Maine mineral prospecting, and canoeing the white waters. This guy is a man of few words, for sure. Next comes "Plaque of New Jersey Mineralogical Society for teaching and diffusion of mineral knowledge." I take it that he left out the fact that it was awarded to him, as no other solution seems to hold water. This award was in September 1969, so it is a fresh piece of news. Forrest, I implore you to get a bit of paper a little larger, and tell us a little more on yourself, the family, etc. The children seem to be 23 and 27, so both are presumably out of college! Where, when, how? Don't mistake my motives, Forrest, I appreciate the little capsules, including yours. I had ten one month not long ago. Many thanks for being kind to us less bright fellas.

Again, we are saddened to hear of the passing of a classmate, **Robert E. Peters,** electrical engineer, of Medfield, Mass. Bob MacCormack mentioned, in a letter, that he had heard this and even though the subject is a bit touchy, I wrote to Mrs. Peters to confirm what might have been a rumor. Margaret replied saying that Bob died September 1 of a heart attack, which was quite sudden, and unexpected. She thanked me for the nice note, and said that Bob would have been pleased to be so remembered. I am grateful to Margaret for being kind enough to reply to a request which surely stirred up something unpleasant. So, Margaret, the Class of 1933 joins me in sending you our kindest sympathy for your great loss which is ours, too. Bob was always particularly popular with his close course mates, as well as with many others. You will hear from the Alumni Association soon, as is the confirmed custom.

That's it, friends.—**Warren J. Henderson,** 1079 Hillsboro Beach, Pompano Beach, Fla. 33062

34

As this month's deadline approached, the larder looked rather bare, but then manna appeared from heaven. During a trip to Boston I saw **Norm Krim** to pick up secretarial records he was passing on to me. Included were two letters that came last May but that I hadn't connected with before. So I hope the writers will realize that the delay is the result in the change in secretaries and not any lack of appreciation for their efforts.

The first letter is proof of the comment I saw in class notes a while back—if you can get the wives to write, you've got it made. It comes from Wendy Culin, as follows—"Following is some information about **Nembhard N. Culin** (my husband), which he asked me to write up and send along for possible use in *Technology Review.* Last fall we made a trip around the world visiting, en route, our daughters—one about to graduate from the University of California at Berkeley and the other living in Paris married to a Frenchman after graduating from Smith College last year (that junior year in Paris!).

"Nem's participation in the late John Wharf's special water color seminars in the old Rogers Building was put to good use in the execution of fifty water colors in places such as a Japanese fishing village, a Hong Kong ladder street, temples in Angkor Wat and Katmandu, Bangkok klongs, Calcutta and Old Delhi street scenes, the Taj Mahal, Corbusier's Chandigarh (capital of the Punjab), the Vale of Kashmir (while living on a houseboat), an old bazaar in Kabul, Afghanistan, and the Greek Islands. We returned home in time to have Thanksgiving with our two sons, one is a student at Syracuse University and the other is at Rhode Island School of Design, the latter following in his father's architectural footsteps.

"Nem has been with Frost Associates, architects in New York, for 22 years and was the associate in charge of the recently completed 35-story staff residence for the New York Hospital which was awarded honorable mention for concrete construction by the Concrete Industry Board."

I applaud Mrs. Culin's efforts and hope she may be an inspiration to any other wives who might feel that their husbands have been shy about telling us of the family doings.

The second letter was the result of George Bull's efforts and comes from **Lee J. Rusling,** who is living in Huntington Hills, Rochester, N.Y. Lee writes: "It's been not quite a year since your inquiry of June 1. My most profound apologies for not having answered sooner. Presently I am all too deeply involved in successfully handling the affairs of many well-to-do clients. After leaving Tech in the early thirties I was lucky to land a job with a small jewelry manufacturing concern, as vice president and sales manager. In 1940, this firm was incorporated, and I built my present home. In 1963, after due process of intensive study, was accredited a chartered financial analyst. Our three children (two boys, one girl) have presented us with five grandchildren to date. As my health is moderately good, I am looking forward to joining that extremely exclusive club of great-grandfathers one of these days."

Another gift from the gods came from **Ted Lucas** through Jim Eder. Ted is running a business as a manufacturer's representative in Tustin, Calif. and tells us: "My apologies are due for failing to reply sooner to your good letter of July 15. At the time it came I was just about to leave on my first vacation in three years, to spend some time at a fishing shack-built-onto-trailer which I have in Punta Cabras, Baja, Calif. This is a beautiful beach area and so far not unduly contaminated with tourists because we have to travel 12 miles of progressively bad unpaved road getting there from the take-off point, 181 kilometers below the boarder—that is, south of Tiajuana. Your new hovercraft business sounds very interesting indeed, and I hope it proves to be most successful. I'd like to learn more about it, particularly since I used to fly a variety of small airplanes until about three years ago. And I'm hoping to start flying again when the time permits.

"My letterhead indicates my business. I've been operating Best Electronics for the last six and one-half years selling aerospace instrumentation products such as Borg-Warner Controls magnetic tape recorders; and a variety of other items made by less well-known companies including transducers, amplifiers, A/D and S/D converters, multiplexers, telemetry systems. Like others in this kind of business, I was doing very well until the huge siphoning of dollars into the Vietnam swamps started curtailing aerospace development programs. Now everyone out here is complaining the lack of funding for even vital R&D, the dollars are being squeezed out through an eyedropper. . . . It was good to hear from you, and if you write again I'll promise not to be so dilatory—just plain lazy—about replying. Best wishes."

Some more unfinished business comes from Alumni Fund responses. From an April 13, 1969 Aiken, S.C. newspaper is a clipping on **Wilcox P. Overbeck.** Some time back these columns mentioned that he had been made director of the du Pont-operated Savannah River Laboratory of the A.E.C. The occasion for the write-up was the presentation of a citation by the A.E.C. for "his outstanding service to the nation's atomic energy program" and it details some of his contributions. From the clipping we find that Bill retired in 1967 then joined the staff of the University of South Carolina to do research and lecture in the field of astronomy. Another atom smasher, **John F. Haines** notes: "With Allis-Chalmer's withdrawal from the atomic energy arena, I

severed my 11-year connection there and joined the A.E.C. Division of Reactor Development and Technology. I'm now concerned with atomic power for the future, but looking at it from the government's viewpoint."

In September **William C. Schumacher** wrote: "Just deposited my son Paul in Cambridge for a graduate program at Sloan. Was much impressed by the service the Institute renders to newcomers in finding housing. Wish the school could do more towards providing it in dorms or apartments." I can't help observing that a comment like this should be remembered when our class president Paul Wing, Jr., writes about plans for our 40th year gift. . . . In November 1965 these columns mentioned **John Burwell, Jr.**'s work with Manhattan College. In an April 1969 press release the National Planning Association announced his appointment to membership on their National Council. After getting his Ph.D. at Tech in 1938, John stayed around M.I.T. and taught there through 1951. He was with Horizons, Inc. from 1951 to 1956 as technical manager, associate director of research, and vice president. In 1956 he became director of research for American Standard, Inc., and since 1962, a vice-president. John is a fellow of the American Physics Society and holds memberships in several other professional and technical societies.

More recently, **John G. Borger,** Chief Engineer, Pan American World Airways was made a fellow of the American Institute of Aeronautics and Astronautics.—His citation reads in part "for his notable contributions in the development of new aircraft for commercial transportation." . . . Finally, from the *Reflector* (publication of the Boston section of I.E.E.E.) we learned that **Arthur Miller** gave an address, *Engineering Problems in Electrocardiography,* an ideal topic for him as you will see. Art took his Sc.D. degree at M.I.T. in 1938, having already started with the Sanborn Co. in 1936. He became involved in the design of electrical measurement and recording systems, including electrocardiographs and other physiological research and clinincal devices. Sanborn merged with Hewlett-Packard in 1962 and Art stayed with the latter until last year when he left to start his own consulting engineering practice.—**Robert M. Franklin,** Secretary, Satucket Rd., Brewster, Mass. 02631

35

At the National Alumni Officers' Conference on September 5 and 6 on campus, the class was represented by Randolph Antonsen, Rufus Applegarth, Phoenix Dangel, Carbon Dubbs, Peter Grant, Allan Mowatt, Bernard Nelson, Charles Debes and William Forster. **William Abramowitz,** who received a certificate of appreciation in the fall for outstanding effort as Special Gift Chairman, was registered for the Conference, but could not attend because of illness. . . . Figures made available by the Alumni Fund showed that the class of 1935 donated more money last year than any class not having a major reunion. . . . **Rufus Applegarth** presided in Huntington Hall for five members of the faculty, who told of their new areas of research at the Institute, and how their activities relate to student education and M.I.T.'s current activities.

In the Miss America contest, Massachusetts was represented this year by Georgina Silvia Hossfeld, daughter of **John Hossfeld.** Georgina made it to the finals. . . . **Charles W. Perry** is now Manufacturing Vice President for the Kendall Refining Company, Division of Witco Chemical Corp. . . . **John S. Holley** wrote: "Have joined the four wheel drive crowd. Anyone out San Diego way who digs this prospecting, rock hunting, exploring jazz, is welcome to join me. Haven't got a trail bike yet, but have plans. After all, a four wheel drive car can only go so far (Yeah—I hoid 'bout dem mules)."

Perry H. Ware: "Now located in Pittsburgh, Pa., as manager of Insulated Conductor Engineering for Alcoa Conductor Products Co. After 29 years with Simplex Wire and Cable Company and 25 years in the same house, this is a very interesting and challenging change. I am enjoying every minute of it." . . . **Bernard B. Berger:** "I have just completed a one-year assignment as water resources specialist in the Office of Science and Technology, Executive Office of the President, and have returned to the University of Massachusetts in Amherst where I am Director, Water Resources Research Center and Professor of Civil Engineering and Public Health."

Roy P. Whitney, Vice President and Dean of Institute of Paper Chemistry, Appleton, Wisc., will receive the 1969 Pulp Manufacturer Division Award of Technical Associtaion of the Pulp and Paper Industry. . . . **Max Wasserman** this year is completing a 500-unit, low-cost housing project in Cambridge, the first to be built in that city. . . . **Albert V. Carlin,** Deputy Chief of the Scientific Information and Documentation Division, ESSA, retired from government service March 1.

George S. Schairer of Boeing has been elected a corresponding member of the International Academy of Astronautics. . . . **Thomas Rinaldo** operates his own sanitary engineering laboratory in Massachusetts and assures safe bathing in the local swimming holes.—Co-secretaries: **Phoenix N. Dangel,** 329 Park St., West Roxbury, Mass. 02132; **Irving S. Banquer,** 20 Gordon Rd., Waban, Mass. 02168

36

In the June *Bulletin of the American Meteorological Society* appears a very interesting account of the Adirondack Conference on Electrostatics by **Bernard Vonnegut** who is associated with the Atmospheric Research Center of the State University of New York at Albany. The U.S. Department of Commerce listing of available reports on the status of air-pollution-control technology lists a report by **Melvin First** and a co-author on the Tenth AEC Air Cleaning Conference held in New York last year.

Herbert S. Potter has moved from vice president, sales, to vice president, domestic and international relations, for Carpenter Technology Corporation, formerly the Carpenter Steel Company in Reading, Pa. The company is moving toward more effective operations in its international business. . . . Captain **C. Donald Brown,** U.S. Navy retired, has been moved by George Washington University to the position of Officer for Continuing Engineering Education.

Several graduate members of the Class are in the news: **Franklin Cooper** of Haskins Laboratories has been appointed to a subcommittee on sensory aids of the National Academy of Engineering. The group is charged with "fostering a national program to bring the benefits of modern advances in engineering, science, medicine, and psychology to the problems of the blind and the deaf-blind." . . . **John E. Eberhardt** has been appointed assistant vice president, research, for the Bethlehem Steel Corporation with which he has been associated since 1938.

Nobel Laureate, **William Shockley** (Transistor Bill) is listed by Bell Telephone Laboratories as one of the developers of a magnetic "bubbles" device which is expected to have important impact on digital data processing. A patent has been or is expected to be issued and time will tell.—**Alice H. Kimball,** Secretary, P.O. Box 31, West Hartland, Conn. 06091 or temporarily 221 Lake View Ave., Cambridge, Mass. 02138

37

Vladimir Haensel of the Universal Oil Products Company, Des Plaines, Ill., is the chairman-elect of the American Chemical Society's Division of Petroleum Chemistry.

Harry B. Goodwin (see photograph on page 126) has recently been appointed Assistant Director, General Administration at the Columbus Laboratories of Battelle Memorial Institute, Columbus, Ohio. Harry has for the past six years, been serving as Assistant to the Director, and his new assignment represents an extension of responsibilities for administrative matters pertaining to the entire Battelle-Columbus operation. A member of the Battelle staff since 1949, he has participated in and managed a number of research programs concerned with metallurgy and with the analysis of technical information. His metallurgical research focused on molybdenum, "ductile" chromium, high-purity iron, and on iron smelting.

Al Busch is President of Keuffel & Esser Company which has moved to 20 Whippany Road, Morristown, N.J. 07960. . . . **George Levy** is President of Chandler Hardware, Newton Centre, Mass. George is also on the advisory board of the Capitol Bank and Trust Co. . . . **Harry Kohl** is now Vice President and Assistant General Manager, L-1011 Programs, Lockheed-California Co., P.O. Box 551, Burbank, Calif. 91503 and is living at 5058 Princess Anne Road, La Canada, Calif. 91011. . . . **Robbins H. Ritter** is a senior research specialist and has recently returned from a cruise to Mexican ports with his grandson, Robbins Gray.

John C. Gibbs is Vice President of Nevada Power Company, Las Vegas, Nevada. . . . **Louis Bloom** left the General Electric Company about nine years ago and is devoting his time to antiques and "anything old."—**Robert H. Thorson,** Secretary, 506 Riverside Ave., Medford, Mass.; Professor **S. Curtis Powell,** Assistant Secretary, Rm-5-325 M.I.T., Cambridge, 02139; **Jerome Salny,** Assistant Secretary, Morristown, N.J. 07960

38

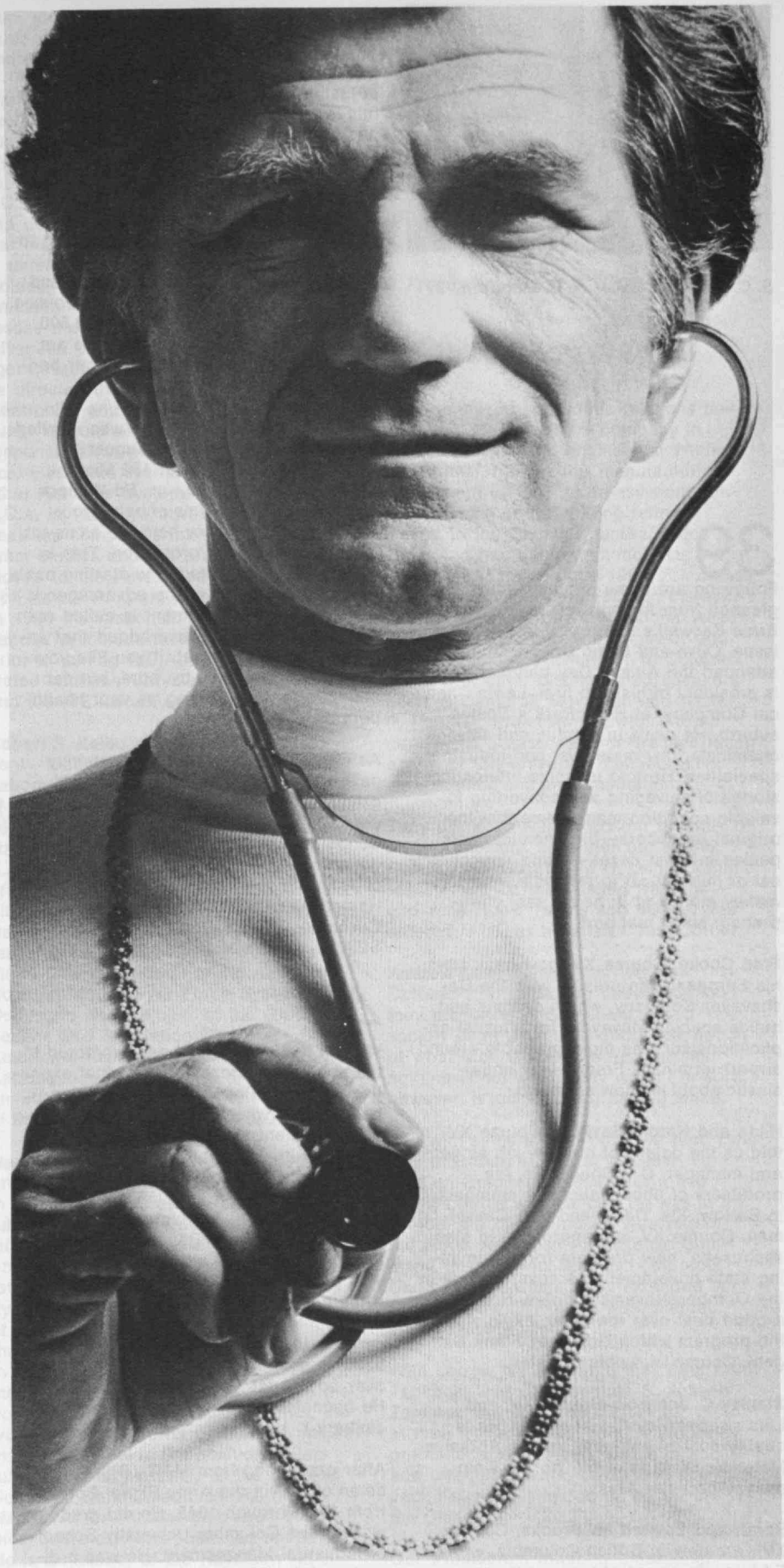
On October 15, a group of us from the New York area, met for lunch at the Chemists' Club; included were Bert Grosselfinger, Fred Ray, Roy Hopgood, Frank Kemp, Paul Desjardins, and Gretchen Birge. It turned out that **Don Severance** and **Roy Hopgood** have a reunion each summer on Lake Winnipesaukee, since they are neighbors up there.

If you will look at the accompanying columns, you will see what happens to a chemical engineer who throws in the sponge. **Bert Grosselfinger** who has given up working for a living, now wears love beads and is a pseudo doctor for TV soap operas and for the residuals that he can get on commercials. Your secretary has recognized Bert's smiling face on a David Frost Show commercial—more power to Bert.

Gretchen Birge changed jobs this year and is now Project Director with Saphier, Lerner, Schindler, Inc., Environetics, a division of Litton Industries.

Bill Preece writes that he has been appointed Manager of Research and Development at the Edes Manufacturing Division of Revere Copper & Brass in Plymouth, Mass. as of October 1, 1969.

The reporter of the month is **Paul Black,** who writes that he missed the Alumni Officers' Conference in Cambridge because his back was bothering him, leaving him in bed that week instead of attending the meeting. He enclosed a clipping which informs us that **Lloyd Bergeson** was named vice president of the parent concern and general manager of the Quincy, Mass., division of General Dynamics Corporation.—**A. L. Bruneau, Jr.,** Secretary, Hurdman and Cranstoun, Penney & Co., 140 Broadway, New York, N.Y. 10005



F. B. Grosselfinger, '38, former chemical engineer, whose face you may now recognize on TV.

S. C. Johnson, '39

H. B. Goodwin, '37

39

Following are some supplementary notes gleaned from Alumni Day, to augment Ernie Kaswell's fine report in last month's issue. Olive and **Irving Cohen,** Course XV, attended the Alumni Day banquet. Irving is president of his own firm, Lewis Chemical Company, of Hyde Park a Boston suburb. He deals in surplus and salvage chemicals, raw materials, and industrial specialties. He told us some interesting stories of salvaging and converting to salable condition many items that the original producers—big chemical companies in most cases—found uneconomical or impractical to rehandle. And Irv makes money at it: he's a real entrepreneur and a real pro!

Fred Cooke, Course XV, now back from his European ventures, is with the Dashaveyor Company, which designs and builds special conveyors for unusual applications such as moving people around airport terminals. Fred is very enthusiastic about his new sales job.

Hilda and **Harold Seykota,** Course XV, told us the details of his new job as general manager, C F Chemicals, Inc., producers of phosphates and ammonia, in Bartow, Fla. Dodie and **Bob Casselman,** Course XV, are engrossed in Massachusetts' new program for streamlining state government, as covered here in the October/November notes. Bob travels a good deal over the state, explaining the program which Governor **Frank Sargent,** Course IV, wants to install.

Stanley C. Johnson, Course XV, and Lois swapped stories at dinner. He is quality control engineer for the Abrasive Materials Division of the Norton Company, Worcester, Mass.

Sarah and **Edward M. Brooks,** Course XVI, are now in British Columbia, where Ed is professor of geology and geophysics.—**Oswald Stewart,** Secretary, 3395 Green Meadow Circle, Bethlehem, Pa. 18017

40

Due to the large volume of mail, a portion of last month's column was held over for this issue. **Jerry McAfee** is now president and chief executive officer of Gulf Oil, Canada Ltd. . . . **Bob Deshon,** professor at the University of Cincinnati, has been a traveler for the past year, as shown by his short letter: "Academic leave from March 1969 to September 1969, travel to England, Scotland, Norway, Sweden, Denmark, Holland, France. Studied and photographed all 88 county court houses in state of Ohio—this alone was 3,600 miles of travel. Found the counties are making every effort to preserve our heritage."

Dick Dunlap advises that he was married to Joanne Spooner Smith August 23, 1969 and is now living at 452 Mitchell Lane, Middletown, R.I. . . . **Ed Wallace** points out the problems of being your own boss: "Have now held the same job for 20 years without promotion. This is one of the disadvantages to starting one's own business. One of the advantages is that the next advancement is called retirement." He might have added that another advantage is that, if you like your work you never have to retire, but can continue to do it as long as your health permits.

As with all of us, **Gary Wright**'s family gets older: ". . . eldest son, Gary will graduate from Yale Medical School; oldest daughter, Judy and her husband teach School in Naknek, Alaska. My youngest daughter, Janet will graduate from Radcliffe in the spring; her husband from Harvard."—**Alvin Guttag,** Secretary, Cushman, Darby & Cushman, 730 15th St. N.W., Washington, D.C. 20005

41

William K. Hooper has been promoted to the position of president and chief executive officer of Republic Foil, Inc., Danbury, Conn., where he has been executive vice president since 1967. Republic merged with National Steel Corporation, Pittsburgh, Pa. as of December 31, 1968. Bill joined Republic in 1955 after ten years with Sperry Products, Inc. He was general manager of Republic Etched Products until 1959 when he became vice president—sales and marketing, while continuing responsibility for the electrochemical division. In 1961 he became a director at Republic. In 1962 he became senior vice president and took over additional operating responsibilities. He became executive vice president on January 1, 1967.

After graduating from M.I.T., Bill served as an officer in the Army Signal Corps from 1941 through 1945. He did graduate work at the Columbia University School of Industrial Management. He was a director of the Aluminum Association in 1965 and 1966 and also served as chairman of its foil division. He is a member of the Electrochemical Society, A.S.T.M., A.S.M., and the National Flexible Packaging Association. He is married and the father of five children.

Franklin W. Kolk was elected a fellow of the American Institute of Aeronautics and Astronautics. He was among 29 honored for this award at an honors and awards banquet on October 23, 1969 in Anaheim, Calif. as a highlight to the A.I.A.A. sixth annual meeting and technical display at the Anaheim Convention Center. Frank's award read: ". . . for his basic contributions to the development of commercial transport, including the Convair ZCO, DC-6, DC-7, Lockheed Electra, the Boeing 707, and Convair 990." He holds the position of vice president, development engineering, American Airlines, Inc.

Jerome Namias was a speaker at the Science Writers Seminar on Weather Forecasting and Prediction, sponsored by the American Meteorological Society and The National Association of Science Writers on October 10, 1969 at the American Meteorological Society headquarters, 45 Beacon St., Boston, Mass. His topic was "The Current Status and Potential of Extended and Long-Range Weather Forecasting." Jerome is chief, extended forecast division, Weather Bureau, ESSA, Silver Spring, Md.

Ivor W. Collins reports: "Summer vacation trip shortened by unplanned upsetting of our travel trailer; no one hurt, and mostly superficial damage to the trailer. Still in G-E Ordnance Systems in Pittsfield, Mass., but working in 'support projects' organization doing planning and programming work, instead of the more engineering-oriented spot I held before. Son a sophomore at Cornell (arts and sciences), daughter in her first year at Emma Willard School in Troy, N.Y., second son in 7th grade." . . . **Otto Zmeskal** has been made a member of the Board of Trustees of Goodwill Industries of Toledo, Inc., Toledo, Ohio.

William G. Anderson serves Harvard University as university marshal. In the weeks before commencement, he spins into a whirlwind of rain plans, seating charts, and diplomatic maneuverings. Dispensing 14,000 tickets, conferring degrees, and dissuading S.D.S.ers from interrupting the "happy observance of commencement" are among his responsibilities. During the rest of the academic year, he is busy entertaining some 850 official University guests, 95 percent of whom are on cultural exchange programs from abroad. Working closely with the State Department he arranges for visitors to meet professors, see the sights, and in general have a good time. His job requires a store of miscellaneous information: he must know not only that the Shah of Iran gets a page to himself in the visitors' book, but also how to house, feed, and iron the clothes of the Shah's 32-person train. An ex-navy man, he gets away from it all on his 52-foot sloop, which he is reported to have designed himself and had built in China. He is married, has three children, and lives at appropriate

seasons in Shelburne, Mass., and Biddeford, Maine.

Charles Wyckoff was a speaker at a two-day seminar of EG&G executives, scientists and engineers of its various subsidiaries held in Santa Barbara, Calif. recently. Charles discussed EG&G's extended range black and white film which can capture the brilliance of a fireball from a high altitude nuclear detonation while retaining the stars in the background of the photograph. He also spoke of the difficulties of color photography on the moon. Astronauts Borman, Lovell, and Anders reported that their color photos of the moon were not accurate. Charles said that they weren't able to take good color pictures there because there is no atmosphere above, no sky to reflect light back onto shadowed areas. Consequently everything in shadow is completely black, with no gradations of color. In addition, the lighted areas are harsh and undetailed because no light is filtered out by an atmosphere. Further, everything gets darker as the distance from the viewer increases. The horizon and its detail are all but invisible. These conditions combine to make color photorgaphy very difficult. He said that his group is now developing for N.A.S.A. an extended range color film that has over 20 layers in the emulsion, which will permit a greater range of color sensitivity than ever before possible.

Milton Sanders was a speaker at the third Annual Conference of the Engineering Societies of New England held last September. His topic was "E.D.P., Use It, Don't Become a Victim of It." Milton is general manager of Systems Division, Sanders Associates, Nashua, N.H. Besides his B.S. in communications engineering from M.I.T., he has done graduate work in physics at George Washington and Catholic Universities.—**Walter J. Kreske,** Secretary, 53 State Street, Boston, Mass. 02109; **Everett R. Ackerson,** Assistant Secretary, 831 Cranford Ave., Westfield, N.J.; **Michael Driscoll,** Assistant Secretary, 63 Center St., Nantucket, Mass. 02554

43

Five of our classmates have been honored with appointments indicating continued leadership in their respective fields. It is always a pleasure to pass this news along to you. **Warren P. Manger** was appointed chief engineer of RCA's astro-electronics division, Princeton, N.J. He was formerly manager of advanced systems and technology, and will be responsible for the design and engineering of spacecraft and space systems. Since joining astro-electronics division in 1958, he has been instrumental in many space projects, including the development of TIROS weather satellites, the three-axis stabilization system for TIROS M (called Stabilite) and lunar and planetary exploration systems. Before joining RCA, Mr. Manger was chief physicist with Farrel-Birmingham, Inc. He began his engineering career as a staff member of the M.I.T. Radiation Laboratory in 1943.

Frank J. Gardiner was appointed manager, systems development and application, for R.C.A.'s aerospace systems division, Burlington, Mass. He will be responsible for overall monitoring of the R.C.A. division's systems engineering and development efforts to assure maximum application of their potential to defense and space programs. This will include responsibility for extensive simulation and analysis designed to assess the feasibility and applicability of advanced concepts. Formerly, as manager of tactical and space programs, he directed the development of control electronics and radars for the Apollo Lunar Module program. He was also responsible for programs in Electro-Optics, Electronic Warfare Systems and other Avionics Systems. Frank joined R.C.A. in 1961 in Moorestown, N.J. to head the company's manned space program studies and LM proposals and moved to the Aerospace Systems Division as LM Program Manager in 1963. In 1966 his responsibilities were expanded to include tactical programs. Prior to joining R.C.A. he was associated with the Chrysler Corporation and the ITE Circuit Breaker Company.

Robert S. Kelso was elected vice president—technical of Cornell Aeronautical Laboratory, Inc. He was formerly director of C.A.L.'s aerosciences division. He has been a member of the laboratory's staff since 1948, and was head of the C.A.L. Transonic Tunnel Department prior to assuming his position as division director in 1957. Before joining C.A.L., he was with the University of Michigan research center. He is a member of the Flight Dynamics Panel of the Advisory Committee to the Air Force Systems Command and member of the Ground Testing and Simulation Committee of the American Institute of Aeronautics and Astronautics. He is author of the article on wind tunnels in the current edition of the *Encyclopaedia Britannica.*

George Freedman has been named new products group manager, a new position in Raytheon's microwave and power tube division. In this position, he will provide management and direction to new products research, development, prototype manufacture, and market feasibility studies. He formerly was manager of the materials and techniques group in the division's microwave tube operation. In this capacity he directed the development of Raytheon's mini furnace and the company's samarium cobalt magnet, the world's most powerful permanent magnet material. He holds the position of lecturer in dental materials at the Harvard School of Dental Medicine. His book, *Handbook for the Scientific and Technical Secretary,* was published in 1967. He is a member of the Raytheon Advanced Research Patent Committee.

F. Curtis Smith has been appointed manager of safety in the American Oil Company employee and public relations department. He joined the company in 1946 as a chemical engineer at Whiting, Ind., transferred to the manufacturing department in 1951 as an assistant general foreman at the Whiting refinery, moved to the Chicago general office in 1953, and has been manufacturing manpower coordinator since 1966. . . . **James B. Reswick** was a participant in the symposium sponsored by the National Academy of Engineering, The Engineer and the City, held in Washington in October along with other distinguished speakers such as Daniel P. Moynihan and Walter P. Reuther. Professor Reswick's topic concerned a case study in transportation action of city-university collaboration and planning and implementation.

G. Freedman, '43

F. J. Gardiner, '43

Tony del Valle was in Boston recently on official business as a member of the Puerto Rico Governor's Housing Committee. He and Carmen visited with Jim and Jane Hoey. Tony's son Manuel has entered M.I.T. as a transfer from Cornell.

Andrew Granese was married last October 25th to Sandra Louise Kenney; they are living in Stoneham, Mass. The society page gave us a good description of what Mrs. Granese wore, but said nothing about what Andy wore. I'm sure, however, it included a great big smile.

It is with sincere regret that we report the loss of **Robert H.** (Pete) **Wheeler,** who died on October 3, 1969 after a five months battle with cancer. He was in the Directorate of Operations Analysis of the North American Air Defense Command in Colorado Springs, Colorado. Class President Jim Hoey extended our Class's sympathy to his wife, Mardee, and the family.

With sorrow we also note that Ruth Adler Tankoos, wife of classmate **S. Joseph Tankoos, Jr.,** died on October 22, 1969 at their home in New York. A Wellesley graduate, she was very active in social and charitable work. Class Secretary Jack Kelly wrote to Joe on behalf of our Class.

Our President's letter to classmates, which you received last October, expressed his observations of how M.I.T. has been applying its great talents to the problems in urban affairs and political

D. G. Black, Jr., '46 *R. C. Cowan, '49*

science. This is being done without sacrificing any of the continuous advances made in science and technology. M.I.T. does not yield to sociological pressures; it meets them head on and contributes to the fields involved. The Alumni Fund, to which our Class has always responded well, helps keep the M.I.T. environment up to date. Have you made your contribution yet?

Most of you will be reading these notes at your winter homes in Palm Springs or Ft. Lauderdale. We certainly must be envied by the younger classes, having reached retirement age. Perhaps this is a good time of year to dash off a four- or five-page letter to your class secretaries describing your arthritis and hardening arteries.—**Richard M. Feingold,** Secretary, 266 Pearl Street, Hartford, Conn. 06103; **A. J. Kelly, Jr.,** Associate Secretary, 34 Scudder Rd., Westfield, N.J. 07090

44

Three more of our classmates took advantage of the back of the Alumni Fund envelope to inform us of their activities. Taking them in alphabetical order, **John B. Gardner,** E.E., recently was named vice president for engineering of the Kerite Company. Kerite is a subsidiary of Harvey Hubbell. John reports that the new postion will require more traveling and he hopes to contact members of the Class from time to time.

Bob Morse, M.G., spent the last year in England as pastor for two London Methodist churches. He visited the M.I.T. Club and participated in the World Council of Churches consultation on Industrial Democracy at Geneva, Switzerland. Being particularly interested in church and industrial relations, he is currently engaged in methods for evaluating and promoting democratic structures for codecision-making in industry. He states he would welcome interest in these matters, especially in the W.N.Y. area (which I assume means western New York). Those of us who have been exposed to McGregor's X and Y theory and have tried participative management may have mixed views on the efficacy of these techniques. Please send your comments to R. R. Morse, 5 Park Ave., Middleport, N.Y. 14105.

Art Peterson, writes he has just been appointed Chairman of a School Board Committee to work with the New York State Education Department on consolidation and reorganization of public school districts in his area. Art appreciates the problems when he states, "This is a fine way to get caught in the crossfire between the local politicians and the power structure.". . . Two papers recently issued were authored by men from our class. **G. P. Curran,** C.M., was lead author of "Studies on Mechanics of Fluo-Solids Systems," sponsored by the Office of Coal Research. **A. A. Fowle,** mechanical engineering S.B., S.M., gave a paper at the Sixth Aerospace Sciences Meeting of the A.I.A.A., "Computer Program for Prediction of Heat Transfer Through Glass." I guess I should add a third, "Survey of Effectiveness of Spacecraft Remote Sensors," in the August 1969 issue of *Photogrammetric Engineering* which was co-authored by your Secretary. . . . Our man-about-town, **Paul Heilman** hit the press again. Paul (MG, XV, SB) is President of the Fairfield County, Conn. M.I.T. Club and chaired a meeting on recent developments in holography.

You will be saddened to learn of the decease of **Frederick L. Hoffman,** C.M., on August 11, 1969. Those of you who know Fred may drop a note to his wife at 48 Fuller Brook Ave., Needham, Mass. 02192. Mr. Fred G. Lehmann, the secretary of the Alumni Association sent her a letter but I'm sure she would appreciate hearing from his classmates.

Here are some recent address changes: A. L. Bryant, Apt. 303, 993 Memorial Dr., Cambridge, Mass. 02138; Andrew Chaplin, Apt. G, 3382 McGehee Rd., Montgomery, Ala. 36111; Conrad Chapman, Box 117, Plymouth, Mass. 02367; Arthur F. Dershowitz, Dobbs Terrace, Scarsdale, N.Y. 10583; Edward Jefferson, 59 West Hill Terr., Naugatuck, Conn. 06770; R. M. Ilfield, 795 Watersedge, Ann Arbor, Mich. 48105; W. C. Kaesche, 435 W. Diversey Pkwy., Chicago, Ill. 60614; Fletcher Moore, Lake Blvd., Box 34, Whispering Pines, N.C. 28327; W. W. Murray, 1051 Swinks Mill Rd., McLean, Va. 22101; J. David Reeves, 72 Edge Rim Rd., Upper Saddle River, N.J. 07401; (Some of these names sound romantic.) Gregory Walsh, Jr., Apt. 3415, 1315 Winrock, Houston, Texas 77027; Robert H. Wood, 131 Benson Ave., Minetto, N.Y. 13115; Lieutenant Colonel Edward Wyruchowski, Jr., Rte. 6, BP 61, Bainbridge Island, Wash. 98110. Send any data on the Class to your Secretary.—**John G. Barmby,** Secretary, IITRI, 1825 K St., N.W., Washington, D.C. 20006

46

These class notes are being written a few days before the M.I.T. Alumni Conference to be held in Cleveland on October 18, 1969. We are looking forward to attending the conference and also the opportunity of meeting more of the M.I.T. alumni, and particularly the members of the Class of 1946. We will report to you on the conference and your classmates in the next issue.

'45 Make Plans Now

ATTEND YOUR 25th REUNION

Your classmates are gathering June 12 to 14, 1970 on the M.I.T. campus. Join us! Write:

Thomas J. McNamara
Engineering Research Center
Honeywell, Inc.
200 Smith Street
Waltham, Mass. 02154

James V. Chabot has been named chief engineer of the Ford Motor Company, Design Center, in Dearborn, Mich. Jim joined Ford in 1952 as an engineer on the company's engineering staff and has held a number of managerial positions during the period of 1952 to 1964. In 1964 and 1965 Jim was a Sloan Fellow at M.I.T. where he received a degree in industrial management. In 1966 he was appointed chief engineer at Ford Motor Argentina, and more recently the product development manager of Ford Motor Argentina. Now that Jim is back in Michigan he and his wife and two daughters will live in Birmingham, Mich.

David G. Black, Jr., has left his position of coordinator of research at Brown University and will now be in charge of a regional office in Providence for Research Corporation as the regional director of the Grants Programs. Research Corporation is a foundation chartered in 1912 to support research at scientific and educational institutions. The foundation will grant three-and-a-half million dollars this year through the five regional offices throughout the nation for physical and biological biomedical sciences, and public health nutrition programs. Dave, his wife and five children will continue to reside on Hartford Pike, North Scituate, R.I. They have a married daughter living in Salt Lake City, Utah. Dave has been active in community affairs, as a member of planning and zoning boards and as Town Moderator of North Scituate. He is also a member of the St. Andrew's Society, University Club and Turk's Head Club in Providence.

The Corporation of M.I.T. announced the appointment of **Edward H. Bowman** to professor of management in the Sloan School. Please send us a note on your activities for your classmates are interested in hearing about you, your work and your families.—**Russ Dostal,** Secretary, 18837 Palm Circle, Cleveland, Ohio 44126

47

After watching the Cleveland Browns lose their concentration, composure and the ball game I couldn't settle down to the task of writing these notes last night. I brought the file with me to the airport this morning and it is very thin or I missed part of it in the murky dawn. In any event we find that **Louis Goodman** is now with the Ford Foundation in the Philippines; Captain **Wayne Meyer** is in Point Hueneme, Calif.; and **George Snyder** in Denver, Colo. . . . **Walt Kisluk** has moved from Greenwich to Fair Haven, N.J. and **Dan Espey** from Maryland to Houston, Texas. These came from the Alumni Office at the Institute and undoubtedly each has an interesting story behind it but I don't have them. No information means no news.

Dave Brillembourg has written that he is now president of the professional engineers organization in Venezuela. This organization, 8,000 strong, is one to which all Venezuelan engineers must, by law, belong. Dave was most active organizing their eighth Engineering Congress. . . . From the clipping services we note that **Charles Hoover** is now executive director of the Military Research division at Bell Laboratories. He has been with Bell since 1954 and in the military research department for the past 11 years. As I said the file is thin so will sign off until next month. Please drop a line.—**Dick O'Donnell,** Secretary, 28516 Lincoln Rd., Bay Village, Ohio 44140

49

I find it takes a little time to get used to the delays involved in the Class notes publication cycle. Stan Margolin's October class letter seemed like a good excuse to cut this column short until I wrote "January, 1970 Issue" at the top of my notes. On reflection, I guess it's easier just to admit I'm busy. . . . Two notes this month come from M.I.T. Alumni Fund envelopes. One "Tell it like it is, baby!", my own, testing the system. The second from **L. Brent Kuhnle,** noting that he is Assistant Vice President, Heavy Construction Department, J. A. Jones Construction Co. with home office in Charlotte, N.C.

Press releases inform us that **Anthony F. Gabrielle** is assistant head of the System Operating Division of American Electric Power Company in New York City and is currently national vice president of Eta Kappa Nu, the electrical engineering honor society; and that **Frederick L. Fletcher** is now manager of the Production Planning and Control Department in the Urethane Chemicals Division of Wyandotte Chemicals Corporation.

From the American Chemical Society comes word that **Robert C. Cowen** (S.B. and S.M. in Course XIX, Meteorology) will receive the $2,000 James T. Grady Award at the 159th A.C.S. national meeting in Houston in February, 1970. This gold medal and cash prize is given annually "to recognize, encourage, and stimulate outstanding reporting directly to the public, which materially increases the public's knowledge and understanding of chemistry, chemical engineering, and related fields." Mr. Cowen joined the staff of *The Christian Science Monitor* in 1950 as a natural science writer. He has been natural science editor since 1957, and is the author of the book, *Frontiers of the Sea: The Story of Oceanographic Research.* Being honored for his many excellent writings on chemical subjects and for his exceptional ability to describe scientific progress in language which the non-scientist can appreciate and understand, his articles have dealt particularly with air pollution, biology, oceanography, and United States and Soviet space ventures. Currently based in London, where he has been assigned to cover international science news, science policies, and significant scientific trends in Europe and eventually in Africa and Asia, Mr. Cowen (see photograph on page 128) continues to contribute his "Science Review" column to *Technology Review.*

The questionnaire sent out to the Class of '49 in connection with our 20th reunion was advertised as being designed for computer processing. From my own involvement with these gadgets, I know I can't blame the computer for the dearth of supporting statistics. Unfortunately, my statistical bent leaves me unsatisfied with simple percentages and averages. Where, oh, where are the distribution functions? And some indication as to how many replied? Nevertheless, herewith some tidbits. Of the respondents, 80% had B.S. degrees, 13% M.S. degrees, and 6% doctorates (all in 1949?); 27% received an M.S. degree elsewhere. If my arithmetic is correct, this means that a total of 46% of the respondents went on to advanced degrees. I wonder if the percentages are any higher today?

Since graduation, 39% report weight gains of 10 to 20 pounds, 16%, 20 to 30 pounds, 8%, over 30 pounds. The other 37% are apparently fooling themselves. Under the heading, Transportation, we learn that two classmates own airplanes, three own motorcycles, and we own an average of two cars per family. We have an average of four job changes since graduation, but only three moves, a funny statistic that. Forty-nine per cent own color television sets, 30% give sex as a hobby and we claim a $25,000 mean salary. With those statistics I don't know whether to laugh or cry. See you next month.—**Frank T. Hulswit,** Secretary, 77 Temple Road, Concord, Mass., 01742

51

Nick Badami's construction company, the Ritangela Construction Corporation, finished erecting the Sullivan County International Airport in Monticello, N.Y. Nick and Rita have four children, Angela, Carla, Patrice and Nick. . . . Dr. **Morton A. Bosniak** is an associate professor of radiology at Albert Einstein College of Medicine in New York City. . . . **John J. Bowden** and wife, Barbara, live in Escondido, Calif. with their four children, Greg, 14, Jay, 13, Laurel, 10 and Russell, 7. John is director of electronic warfare at Ryan Aeronautical Co., a subsidiary of Teledyne. . . . **William K. W. Chen** received his Ph.D. in polymer chemistry from Polytechnic Institute of Brooklyn in 1958. He worked for Celanese Plastics Co. in Clark, N.J. and was manager of R&D when he left to become vice president of Aincel Co., Inc. an exporter of plastics products and resins for Celanese Plastics Co. He lives in Berkeley Heights, N.J. with his wife, Catherine, and sons Ronald, 11 and Curtis, 9.

Charles A. Compton of Phillips Exeter Academy in Exeter, N.H. has been placed on the Executive Board of the American Association of Physics Teachers. . . . **Rane Curl** is with the Oak Ridge National Laboratory in Oak Ridge, Tenn. . . . **Charles E. Elliott** has been appointed chairman of the computer committee of the Illuminating Engineering Society. The committee studies reports on the use of computers in the illumination field including photometry and calculation of predicted illumination and brightness values. . . . **Ed L. Fitzgerald** is busy in Europe setting up computer software companies for Control Data Corp. under the CEIR name. Operating groups are established in Holland and Germany with more planned for Scandinavia and southern Europe. Ed's address is CEIR NV, Plaats 24-A, Den Haag, Holland.

Last report on **Russell B. Hodgdon, Jr.,** was that he was assistant research director for Ionac Chemical Co. in Birmingham, N.J. and was living in Morristown with wife Doris and children, Gail, 11, Paul, 9, and Ellen, 7. But I just received notice that he is now living in Sudbury, Mass. Want to square us away, Russ?. . . Professor **Charles R. Houska** has recently been appointed to the position of head of metallurgical and ceramic engineering at the Virginia Polytechnic Institute. . . . **Carl Huntsinger** is executive vice president and general manager of Vetco Offshore Industries, Inc. He spent two years as research and design engineer with Douglas Aircraft Co. then worked for Shell Oil Co. in the development of their offshore technology practices. As a result of this experience, he has oriented Vetco's operations into the offshore area.

Morley (Bud) **Kahn,** wife Yvette and son Adam, 3, live in Bryn Mawr, Pa. Bud is director of marketing at Dynaco, Inc. of Philadelphia, Pa., manufacturers of high fidelity components. . . . Dr. **Wallace B. Lebowitz** has been elected president of the Greater Bridgeport Heart Association. He is married to the former Sylvia Greenberg of Cresson, Pa. and they have three children, Adam, Lisa and Nancy. Wally specializes in heart and circulatory diseases in adults and children and practices in Bridgeport, Conn. . . . **Charles E. Maki** has been appointed president of Whirl Jet Corp. manufacturers and distributors of hydro massage and therapy pool equipment for home and commercial use. Charles was formerly associated

with Ameco, Inc. and the Aerospace Division of Honeywell, Inc.

Tom McLaughlin has written a paper on the role of Ionomer films in skin packaging. He joined duPont in 1951 as an engineer at the Louisville plant working on chemical pilot plant studies. In 1954 he went to the Wilmington headquarters where he did plant engineering cost studies. In 1956, he joined duPont's Chestnut Run Laboratory where most of his work has been in heat sealing research.

David Pellish, M.A.R. IV-B, writes that he completed work as assistant director of the National Commission on Urban Problems and is now executive secretary to a special panel of experts on housing under the Commerce Technical Advisory Board, whose function is to advise the Secretaries of Commerce and Housing and Urban Development on housing technology. . . . **G. M. Potter** co-authored a paper on silver recovery from waste photographic solution by metallic displacement. Gordon is with the U.S. Bureau of Mines. . . . Mrs. **Janice** (Rittenburg) **Rossbach,** S.M. Course XVII, Weston, Mass. is an engineering specialist in the systems engineering lab at Sylvania Electronics Systems, in Needham, Mass. . . . **Selden Spangler, Jr.,** is vice chairman of the San Francisco section of the American Institute of Aeronautics and Astronautics and was involved in establishing a code of ethics for A.I.A.A.

Charles Terrell writes that he is self-employed and deals in land, timber and cattle. He advises one and all to eat more beef to beef up his bank account. His card was postmarked Cairo, Ga. I wonder if he's developing cattle with humps full of tenderloin. . . . **Jim Weisel,** S.M. Course I, lives in Oradell, N.J. with wife Jean and children Gary, 12, Tom, 9 and Karen, 6. He is an account executive with Merrill, Lynch, Pierce, Fenner and Smith in Paramus, N.J. . . . Happy New Year from— **Walter O. Davis** Assistant Secretary, 346 Forest Ave., Brockton, Mass. 02402; **Howard L. Levingston,** Secretary, 358 Emerson Road, Lexington, Mass. 02173; **Marshal Alper,** Assistant Secretary, 1130 Coronet Ave., Pasadena, Calif. 91107; **Paul Smith,** Assistant Secretary, 11 Old Farm Road, N. Caldwell, N.J. 07006

52

The active members of our Class continue to produce a steady flow of news releases regarding their activities. Computer Machinery Corporation of Los Angeles has announced that **Paul Van Alstyne** has been appointed a vice president. Paul will continue to serve as general sales manager. He is a Course II graduate with an S.B. and an S.M. degree. . . . Planning Research Corporation of Los Angeles announces that **James Alan Morris** has been promoted to senior associate. He is a member of the Systems Evaluation Department located in the firm's Huntsville, Ala. office. Morris has been with Planning Research since July 1968. He, his wife and three children live in Huntsville.

Anser Analytic Services Inc., Church Falls, Va. has announced that **Robert M. Oliver,** vice president of planning and analysis at the University of California, Berkeley has been elected to the board of member trustees of Analytic Services Inc. Bob joined the faculty of the University of California in 1961 and was named chairman of the Department of Industrial Engineering in 1964. He was professor of Industrial Engineering in Operations Research in 1965. He holds a bachelors degree in Physics and a Ph.D. in Operations Research from M.I.T. He was a Fullbright scholar in London during 1953 and 1954. . . . **Ed Selig** writes that he recently resigned from Amphenol Corporation to take a position with Audio Devices, Inc. a subsidiary of Capitol Industries. As product manager of their video tape line, Ed is now living in Stamford, Conn. . . . A note from **Curtis M. Hellenbrand** indicates that he has joined the research and development department of the electron dynamics division of Hughes Aircraft Co., in Torrance, Calif. as senior staff engineer. He is engaged in research and development efforts on broad band high power traveling wave tube amplifiers.

Our classmates in the air force continue to do very well. A note from **Dick Wingerson** says that he is still with the air force as a Lieutenant Colonel and has now become Deputy for Research and Development at the Air Force Systems Command West Coast Study Facility in Los Angeles. . . . A news release from Tinker Air Force Base, Okla. indicates that Lieutenant Colonel **Dan Lufkin** has received his second award of the U.S. Air Force Commendation Medal at Ent Air Force Base, Colo. The commendation was for meritorious service while assigned to the U.S.A.F. Environmental Technical Applications Center, Navy Yard Annex; Washington, D.C. Colonel Lufkin is now Director of the Solar Forecast Facility at Ent A.F.B. He has the S.B. and S.M. degrees in meteorology from M.I.T. and a Ph.D. from the University of Stockholm, Sweden.

Stanford University News Service has announced the appointment of Professor **Edward J. McCluskey** as director of the newly created Digital Systems Laboratory, Professor McCluskey received an S.B. and S.M. degree in electrical engineering, Course VI-A and an Sc.D. in Course VI. He is professor of electrical engineering in computer science and has served as professor of electrical engineering and director of the University Computer Center at Princeton University.

Professor **Dana Mayo,** chairman of the Bowdoin College Department of Chemistry, has been awarded a special scholarship from the National Institutes of Health. The grant will be used to help support research by Professor Mayo at the University of Maryland during the 1969-1970 academic year when he will be on sabbatical leave from Bowdoin working on the Raman spectra of biological molecules with Professor Ellis Lippincott.

A note from **Clifford H. Morse** indicates that he has undertaken the role of project architect for his firm, The Architects Collaborative in Cambridge, Mass. on the design of a new dormitory on M.I.T.'s west campus adjacent to MacGregor House. . . . A news clipping received from **George R. Roy** a civil engineering graduate indicates that he has become a consultant to the acting city manager of the city of Yonkers, N.Y. on matters relating to the Department of Public Works. Mr. Roy is special assistant to the director of Marine Terminals of the Port of New York Authority. . . . **Gilbert B. Solitare,** M.D., writes that he is an associate professor of neuro pathology at Yale University.

The supply of news this month has been somewhat less than usual, despite the accumulation of material over a two month period. Please do not hesitate to write of your activities both professional and personal. Any news of classmates active in your vicinity will be much appreciated.—**Arthur S. Turner,** Secretary, Lowell St., Carlisle, Mass. 01741 or Baird-Atomic, Inc., 125 Middlesex Turnpike, Bedford, Mass. 01730

53

John Ehrenfeld, after several years of working in the Boston area for various research-based companies, has recently established his own firm, Walden Research Corporation. Walden Research is oriented principally to the pollution control area, and it has recently obtained two contracts from the U.S. Department of Health, Education, and Welfare. John and his family live in nearby Lincoln, Mass.

Chuck Homsy is now research professor of orthopedics at Baylor College of Medicine in Texas. Chuck has been very active in the area of biomedical engineering and is particularly interested in new materials that may be used by surgeons for implantation. . . . **G. Dausman** who works in the Washington, D.C. area has recently moved to 11218 Country Place, Oakton, Va. . . . **Joe Spracher** wonders why he hasn't received a copy of the class statistics which were developed during the 15th reunion, and what has happened to the class notes. In registering Joe's complaint (or implication) that less information has been coming from the class officership than has been going in, I almost forgot to mention Joe's situation. Joe works for Xerox Corporation in Rochester and he lives in Webster, N.Y. As of a year ago, Joe and his wife, Joan, have three daughters, all of pre-school age. **Marty Wohl** who writes from Washington has also been wondering about the class notes and whether the present Class Secretary shouldn't be impeached along with some of the politicians in our capital.

Alan Hoffman, one of the more talented course members of our class, is still at M.I.T. and is now an associate professor of chemical engineering. Al has two children. . . . **Joe Casanova** apparently does not have time to follow the same pursuits as his namesake in literature. Joe has recently been appointed a full professor of chemistry at the California State College, Los Angeles. He formerly taught at the University of Indiana. Dr. Casanova and his family live in Monterey Park. . . . **Jack Sample** has recently joined Computer Systems Engineering, Inc. of Burlington, Mass. as manager of transportation systems. Jack was previously vice president and secretary of Computer Traffic Controls, Inc. As one who faces the daily traffic snarl around Boston, Jack's interest in transportation, traffic, and highway research offers some hope to the rest of us. He and his wife, Janice, and family live in Stoneham, Mass.

Herbert Richardson says he "never got out of M.I.T." Herb is now a full professor of mechanical engineering. He favors going to Bermuda for our 20th reunion—how do others feel about it? . . . As of a year ago, **Howard Stern** lives at Roslyn Heights, New York (Long Island). Howard has started his own company—developing disposable items for hospital and medical use. Howard's wife, Linda, is a willowy southerner from Charleston, S.C. who reminds me of Scarlet O'Hara. . . . **Fred Cronin** works for Litton Industries and lives in Melville, N.Y. Fred had estimated that Litton stock would rebound to about 115 by June, 1969. Too bad, Fred!

Hal Switendick apparently still lives in Alburquerque, N.M. and works for Sandia Corporation. Hal and his wife, Judi, have a young daughter. . . . **Mike Gruenbaum** is the Chief Transportation Planner for the Boston Redevelopment Authority. As we all know, successful development of new transportation systems in our burgeoning urban areas is not easy. Mike's work, incidentally, is receiving national attention.

We are now starting to run slim on news from the Class, so please let me have word of any of your successes or near-misses which can be committed to public record. And how about a place for our 20th reunion? Do we have any swingers who want to join Herb for Bermuda or points south?—**M. C. Manderson,** Secretary, Longley Rd., Groton, Mass. 01450

54

Stanley Kolodkin has been promoted to manager of tactical and space programs at R.C.A.'s Aerospace Systems Division in Burlington, Mass. As manager of Electro-optics and controls engineering he has been responsible for several R and D programs on laser, low light level TV, and other electro-optical systems as well as the development of several of the Apollo Lunar Module Control Systems. He, wife Judy, and their three children reside in Lexington.

William Marshall is chairman of the National Academy of Engineering's committee on the interplay of engineering with biology and medicine. He is associated with the University of Wisconsin.

Dr. **Norman Masse** has been appointed to the staff of the newly formed Biomedical Research Laboratories of the American Hospital Supply Corporation in Boston. These laboratories have been formed to investigate application of new technologies and scientific theories to medical and health problems and to support American's divisional R&D activities.

George Sebestyen has joined Sanders Associates Inc. of Nashua, N.H. as vice president, systems engineering. He was formerly associated with the office of the director of defense research and engineering where he served as assistant director for tactical systems plans and analysis. Dr. **Marshall Daniels** has been promoted to associate professor of clinical pathology at New York University College of Medicine. . . . **Ablert Nash** has recently been appointed President of Cybervox Systems Inc., concurrent with his responsibilities as President of Educational Technology. In the new position, he will be responsible for national distribution of educational systems in the Language Laboratory and Dial Retrieval fields.—**E. David Howes, Jr.** for **George Inada,** Secretary, 6001 Chatsworth Lane, Bethesda, Md. 20014

55

As always it seems strange on a brilliant October day to be wishing you a Happy New Year, but better this than missing the opportunity. . . . **R. Paul Carroll** reported from Cleveland this spirng that he was at Case in the fifth year of studies for his doctorate in fluid mechanics. . . . From Carnegie **Edward Bryan,** who lives in Pittsburgh, recently received a master's degree in chemical engineering. . . . On the other side of the academic fence **Walter Rubin** has become associate professor medicine and anatomy and chief of gastroenterology at Woman's Medical College of Pennsylvania; so he and Naomi and their five children have moved from New York City to Philadelphia.

Robert Wilcox, S.M., writes that in January, 1969, he became product manager, waste treatment, of the Graver Water Conditioning Co., Union, N.J., a division of Union Tank Car Co. (now known as Trans Union Corp.) as part of the program in progress at Graver toward more active participation in the important field of pollution control. He, Nancy and their children Craig (15), Cindy (13), and Cathy (11) now live in Berkeley Heights, N.J. . . . On March 31, 1969 (glad it was not the next day.), **David Snider** was elected executive vice president of Sawyer Associates, Inc. of Chelmsford, Mass., and of the Chelmsford Manufacturing Corporation. C.M.C. produces identification modules for the railroad car identification program. Sawyer Associates, a supplier to the electronics industry, has some products presently on the market and more forthcoming—or possibly already available as we write. **Jack Scarborough,** S.M., reported in May in a note postmarked Rockville, Md., that he has resigned as an officer of the N.U.S. Corporation and beginning July 1 would organize a new firm to offer technical and economic consulting services. . . . **Lawrence Brown** writes from Santa Barbara that he came to California in 1968 to retire and is still trying. He closed his management consulting firm, which operated from Switzerland, in 1966; resigned four remaining memberships on boards of directors in 1967; but apparently has not yet been able "to reduce activities below the insanity producing level." . . . **Gerald Perloff** reported a new and different address in the spring, having moved from Long Island to Brussels, Belgium.

Captain **Leslie Williamson,** S.M., has been transferred to 11th Coast Guard District, Long Beach, Calif., where he is chief of the Engineering Division. . . . Major **Ernest Strait** and Roma have moved to South Carolina, where Ernest has assumed duties as base civil engineer and commander of the 113th Civil Engineering Squadron at the Myrtle Beach A.F.B. Since receiving a master's degree in industrial engineering from Stanford in 1963, he has completed a tour of duty in Vietnam and graduated from the Air Command and Staff College at Maxwell A.F.B. in Alabama . . ."Having a wonderful summer with my family (wife and three girls)" was the word from Major **Rodney Logan,** who returned in July from Vietnam after a year as Executive Officer to the 37th Signal Battalion in Danang. In September he was scheduled to report to the headquarters of the Defense Communications Agency. Though Rod failed to mention it, a report from the army reveals that he received the Bronze Star Medal shortly before leaving Danang "for meritorious service in ground operations against hostile forces in Vietnam."

What a pleasure once again to have a confidential from Toby and **Dave Brooks,** Jake, now in junior high, and Naomi, a fifth grader. It was received though addressed to an address two moves and seven years ago! The Brookses report that this year vocational and avocational activities, school, health, etc. "differ only in matters of detail from last year's list;" but those of us who are a bit behind would enjoy some more detail.

We must inform you with regret of the death of **Carlton Tillinghast, Jr.,** of Brookline in July and express our sympathy to Suzanne and other members of his family.—Secretaries: **Mrs. J. H. Venarde** (Dell Lanier), 16 South Trail, Wilmington, Del. 19803; **L. Dennis Shapiro,** Aerospace Research, Inc., 130 Lincoln St., Boston, Mass. 02135

56

On October 4 and 5 in Cambridge the Alumni Association sponsored a seminar

on starting your own business for 300 recent graduates in which **Bill Grinker** was a guest instructor. . . . **Hugh Bradley** writes he was promoted to Head, Mathematical Services at the Upjohn Company last year. . . . Last summer **Dean Karnopp** was appointed professor of mechanical engineering at the University of California in Davis. In addition, in October he received the Franklin Institute Louis Levy Medal for a study made on the stability of the high speed trains of the future. . . . **Dick Mateles** has co-authored an article, "Control of Mixed Substrate Utilization in Continuous Cultures of Escherichidoli." Apparently this relates to studying the control mechanisms of metabolism. . . . In the category of unfinished news items we find that **John Pierce** has resigned as an assistant professor at Tech—but the *what now* space is empty.

Alex Rose has formed his own company, Arnott, Rose and Bennir, Inc., general contractors and consultants, on 34th Street in New York City. . . . While walking through Kendall Square one evening I met **Jack Saloma** and found out that he will soon go on a sabbatical to be codirector of The Study of American Political Parties, sponsored by The Twentieth Century Fund. Jack is planning to incorporate the findings in another book to be published before the 1972 elections. In 1969 Jack published *Congress and the New Politics,* his contribution to the American Political Science Association's Study of Congress series.

Looking over the annual report of the Alumni Fund, which came in September, we see that our Class is holding up its end of things very well. Our 50% participation in the 1969 Fund is second highest among the last 25 classes to graduate, and three points above average for all classes. Kudos to **John Morefield** for his good work as Class Agent. Ten other classmates served as Chairmen in regional programs: Richard Clapp, Santa Monica; Bill Grinker, Framingham; Nereo Agostinelli, North Adams; Ted Korelitz, Waban; Bjorn Rossing, Minneapolis; Harold Friedman, Mountain Lakes; Bob Mansperger, Cleveland Heights; Gordon Black, Mansfield, Ohio; Ed Boggs, Harrisburg; and Paul Luckett, Midland, Texas. Together these chairman get credit for bringing in 515 gifts—certainly a big help in making 1969 another record year for the fund. Despite our good participation, however, we were beaten in the dollar column by classes on both sides of us. Must be "bad class origins," as they say in China.—Cosecretaries: **Bruce B. Bredehoft,** 3 Knollwood Drive, Dover, Mass. 02030; **T. Guy Spencer, Jr.,** 73 Church St., Weston, Mass. 02193

57

Happy New Year. As I write this column it's early October. Thus, if you would like to hear some old news read on. . . . **Elliot Wolk** resigned from Salomon Bros. & Hutzler to join Shearson, Hammill & Co. Inc. as first vice president and manager of the Institutional Block Stock Department. In September the Wolks added a daughter to their family which included two sons. Nancy and Elliot vacationed in Japan and Hawaii last spring with Janet and **Roger Yaseen.** . . . **Bob Holton** has left Cowles Chemical, a division of Stauffer Chemical Company, where he served as manager of the Joliet, Ill. operations, to join the Lindblad Construction Company of Joliet as general manager. Bob is president of the Will-Grundy Manufacturers Association, has been active in the Rotary Club and Junior Achievement and is on the board of the Family Service Agency. Bob and his wife have two children. . . . **Henry Eder** and his wife, Elena, have two boys. Henry is executive director CVC, an autonomous public agency in charge of water and power development in the Connecticut Valley.

Dick Swallow has been promoted to full professor in the School of Architecture at the University of Texas. He serves as a member of the University Council and Faculty Senate and was chairman of the sub-committee on ethnic and minority problems. . . . Rosalie and **Bob Rosin** have a second daughter. Bob is vice chairman of the Department of Computer Science at the State University of New York at Buffalo. He reports that, "we have 80 graduate students and a rapidly growing reputation. Academic life still suits us fine."

Mike Brenner is now a senior associate of Inter Action Dynamics, Inc. A recent news release from this organization read in part as follows: "Twenty-three black and white psychologists have teamed up with a Protestant minister, an assistant District Attorney and a group of computer experts to apply psychological methods to costly industrial, college and community conflict situations. Crisis prevention teams move into existing groups, evaluate points of hostility and agreement, and set up 'talk out' sessions so that all sides can work towards constructive aims. Psychology must move out of the doctor's office and into the actual world if there's any chance at all of dealing with much of the discord tearing at American society. This opinion is shared by 23 psychologists who've banded together to form a new Kind of crisis-fighting organization called InterAction Dynamics." Mike received his doctorate in engineering at Johns Hopkins and worked for a number of years with Bell Telephone Laboratories. He presently holds the rank of associate professor of management at the New York University graduate school of business administration and serves on the editorial board of the *Journal of Industrial Engineering.*

My wife, Betty, spotted **Jim Chorak**'s picture in the International *Herald Tribune* (Paris) with the news that Jim has been named vice president, European area, for Hughes Aircraft International, headquartered in Brussels. A letter from Jim arrived a few days later. He and his family, two boys and a girl, are enjoying Brussels very much. More tidbits in February.—**Frederick L. Morefield,** Secretary, Tiirasaarentie 17, Lauttasaari, Helsinki 10, Finland.

58

Seen drinking Irish coffee at a favorite San Francisco cafe were Bebe and **Gary Fallick,** yours truly, and a crowd of M.I.T.ers from other classes, during the Wescon Show. Gary and Bebe had spent most of the day on wine-tasting tours so that by the time we met and had several more Irish coffees, everything in San Francisco had taken on a warm glow.

Pete Lynch has become personnel director at the Texas Instruments facility in Attleboro, Mass. Pete returns to the personnel department after a year and a half as plant superintendent of the precision engineering parts department. Prior to that he spent about three and one-half years in personnel in a variety of responsibilities. . . . **Richard Metayer** was recently promoted by General Dynamics Corporation, Electric Boat Division, of Groton, Conn., to the position of chief hull and structures designer in the atomic submarine program. Dick and his wife, Dolores, have two sons, and they are living in Mystic, Conn.

At R.C.A., one of the winners of a 1969 David Sarnoff Outstanding Team Award in science was **James Goodman** for the development of a time-sharing system for the Spectra 70/45 computer. Jim was part of a project team at the Systems Programming Research Laboratory in Princeton which developed this system. **Daniel Anderson** is a geochemist in the Lunar Receiving Laboratory of the National Aeronautics and Space Administration's Manned Spacecraft Center in Houston. Dan's responsibilities include the operation of the quarantine facility for the astronauts, spacecraft and specimens gathered on the lunar surface. . . . **Robert Slott** has been appointed director of synthetic rubber research and development at Shell Development Company's Emeryville, California research center. Before this promotion, Bob has served as head of the Organic Chemistry Department, research department head, and research supervisor. . . . At Shell's Chemical Plant in Geismar, La., **Stephen Shain** has been named manager, technical department.

We received a newspaper clipping from C. A. Clark, Secretary of the Class of '21, containing news about **Eddy Changkasiri.** He is serving as Principal Secretary of Thailand's Ministry of Industry and has now completed a six-month stay in the United States after having received an Eisenhower Fellowship for Thailand. He served as a Thailand Delegate to the United Nations' Industrial Development Section in Athens, Greece, and the U.N. Commission on Trade and Commerce at New Delhi, India.

In Vietnam, Dr. **Martin Victor** is the director of base medical services at Binh Thui Air Base. In this post, he serves as part of the Base Air Force Team that provides

medical and dental care for Vietnamese villagers living in isolated hamlets in the Mekong Delta. During his own weekly visits, he and his team mates provide care for as many as 400 patients during their half-day visit.—**Michael E. Brose,** Secretary, 199 Sudbury Rd., Concord, Mass. 01742; **Antonia D. Schuman,** Assistant Secretary, 22400 Napa St., Canoga Park, Calif.

59

Seeing my first column in print has encouraged me to sit down at my desk and put together this next collection of potpourri from our classmates around the country. My predecessor, **Glenn Zeiders** writes to wish me luck on my next five years of writing (it's gonna take more than luck!). Glenn comments that he is thoroughly enjoying his retired status. He is still employed as a principal research engineer at Avco-Everett in charge of engineering of a major project in lasers. His major outside interest now is in preparation for the upcoming ski season. . . . On the subject of skiing, **Bob Polutchko** writes that he, too, is getting ready for another ski season in the Colorado high country. He relates that playing basketball at 6,000 feet altitude keeps one young and in constant need of artificial respiration! Bob is currently project engineer for Aerothermodynamics for the N.A.S.A.-Martin Viking Program.

William Towle informs us that he is now manager of the Operations Analysis Department at the Avco Systems Division. He and his wife, Faith, have two boys, Andrew (3) and Steven (2) and have recently built a contemporary home in Andover, Mass. . . . A note from **Frank Koppelman** states that he has become manager—systems evaluation section of the Tri-State Transportation Commission. His responsibilities involve developing and applying techniques for the evaluation of public capital investments in the Tri-State Region covering 8,000 square miles in and around New York City.

Jim Brown writes that he has recently joined the technical staff of Four-Phase Systems, Inc. in Cupertino, Calif. Jim informs us that his wife, Dotty's brother entered M.I.T. this year as a freshman and has even pledged his fraternity, Sigma Epsilon. . . . **Howard Fabry** has recently joined the staff at the Albany Regional Office of the New York State Department of Health. . . . **John Swenson** writes "my wife and I have moved to Toronto—I, as programming manager at the Institute of Computer Science and my wife, as assistant professor in the Department of Computer Science (all at the University of Toronto). More importantly though, we also had our first child, Lisa Kristin. New jobs, new house and new family—what a year!"

Wayne Worrell writes that he will be on sabbatical leave from his position at the University of Pennsylvania until July 1970 at Imperial College of Science and Technology, University of London. . . . **Chuck Staples** has recently joined the staff of Multicomp, Inc. in Waltham, Mass., a newly organized company offering computer time-sharing services. . . . **Steve Parkoff** dropped a note recently announcing the birth of a daughter, Heather Lynn who joins a brother, Seth and sister, Susan. Alright, now do I get a cigar?

For the first time M.I.T. held a Seminar for Young Alumni at the Institute last October 4 and 5. It proved to be very successful. The meeting which treated the subject how to start and operate a small business, was a complete sellout with over 300 young alumni in attendance. Among the '59'ers who attended were: Joaquin Borrero, John Brackett, Charles Crawford, Ollie Fillippi, Burrell Hatcher, Alf Jacobsen, Dick Kocka, Joel Lazar, Dave Ludwig, Bill Marcus, Sylvester Miniter, Ken Molloy, Harrison Morse, Al Oppenheim, Mel Platte, Jack Pogarian, Dennis Posey, Bill Putt, Bob Rosenfeld, Jim Russell, Bob Schumacker, Novis Smith, Ron Stone, Ed Talley, Frank Trantanella, John Van Raalte, Ed Vrablik and Ron Wempen. The general consensus of the budding entrepreneurs in attendance was that it was an excellent session with many valuable ideas presented. Chances are that the program may be repeated in other locations if enough interest is expressed by young alumni.

On the subject of new enterprises, my own venture, Technical Forum Associates, Inc., is entering its second year of operation with a series of technical seminars around the country in many subject areas of critical interest to the industrial community. Anyone interested in getting on the mailing list can drop me a line at the following address.—**Arthur J. Collias,** Secretary, TFA, Inc., 545 Technology Square, Cambridge, Mass. 02139

60

I'll give the monthly plug for the reunion —June 12-14, 1970, at the Jug End in South Egremont, Mass.—and then get down to business. We've got all kinds of news to catch up on. . . . **Fred** and Billie **Kinch** have a baby boy, Matthew Stuart—born September 29, 1969. . . . **Yves Giroux** is now head of the Department of Civil Engineering at Laval University in Quebec, Canada. . . . **James Davis** reports that his first child, Andrew, was born in October 1968; James is Associate Professor of Chemistry and Assistant Provost of Oakland University in Rochester, Mich. . . . **Bob Mapes** has recently been promoted to Controller of Cary Instruments, a Varian Subsidiary (postmark is Arcadia, Calif. which presumably is where that is). . . . **Radoslav Zuk** participated as the only North-American guest lecturer in the symposium on church architecture at Neudorf Castle in Austria in the summer of 1968. . . . **Dave Camenga** has finished his Neurology Residency at Barnes Hospital (Washington University) in St. Louis. He's now in the Public Health Service for two years and is assigned to the PHS Hospital in Staten Island.

Bob McCullough received his Ph.D. from Stanford in 1968 and is now Manager of Systems Engineering at Peripheral Systems in Sunnyvale, Calif. He is married to the former Virginia Crocker and they have four children. . . . **Ray Ambrogi** is plant manager for Pilot Plant II at the Corning Glass Works in Corning, New York.

Roger Townsend is with T.R.W. Systems in Redondo Beach; he's a staff engineer in Information Systems—defense, civil and some commercial applications. Roger says he wrote a long note and it never showed up in the notes. That's entirely possible—my "files" are a total mess at this point. They haven't really been fixed since 1965. Right now I have a neatly labeled folder for each member of the class, and in it is a little card which has the address which was being used in 1965. I also have a large (and growing) file marked "to be filed" in which I have carefully placed every change of address notice, letter, notes, etc., since 1965. In about a week the size of "to be filed" is going to exceed the size of the other 800 or so files combined. I'm thinking about it, I'm thinking about it.

Ken Myers writes that he is "living in a Philadelphia suburb and enjoying it thoroughly. I am in law practice in a large firm with offices here and Washington, handling public utility matters, conglomerates, and—inevitably—the local school board which must have an opinion on whether it can order high schoolers to cut their hair when it covers their eyes and their reading is affected. Glad to see any classmates who may venture through." Ken is married and has two children—Jon, age two-and-a-half, and Lisa, age five. . . . Efficient **Dick Kaplan** sent a summary: "Summary of five years: Unchanged—car, wife, haircut. New—California, two kids (one of each), house, job (associate professor, U.S.C. Department of Aerospace Engineering), twenty-five pounds [gained or lost?—Sec.] debts, smog, freeways. Plans—survival."

Bob deMichaels is now an instructor of physics and atmospheric science at the U.S. Air Force Academy and will be promoted to Major during the next fiscal year. He received the Air Weather Service (U.S.A.F.) Merewether Award for his "significant technical contribution to meteorology" while serving at Nakhon Phanom, Thailand, during 1968. It is one of five A.W.S. Commander's awards presented annually to individuals. Bob says "It's great to be home and back in Colorado.". . . **Tom Thiele** is "enjoying a challenging position as manager of an electronics R&D group at Allis-Chalmers." In 1968 Tom won the annual award for engineering eminence for development of a unique solid-state lift truck control used in AC's lift truck line since 1964. He and his wife Mary are just about finished with their new home; Tom says that "final completion seems to require more work the closer one comes."

Ron Berry is living in Dickinson, Texas, with his wife, Genelle, and two daughters, Cynthia, five, and Catherine, two. He is chief of the Lunar Mission Analysis Branch of N.A.S.A. Manned Spacecraft Center in Houston with responsibility for designing the Apollo lunar mission trajectories. . . . **John Beckett** has been president of R. W. Beckett Corporation in Elyria, Ohio for the past five years. They manufacture oil and gas burners for residential heating units. He says, "With my wife Wendy and three children, ages one through six, I am happily—and we think permanently—situated in Elyria." See you in June. Keep the cards and letters coming—**Linda G. Sprague,** Secretary, 10 Acorn St., Cambridge, Mass. 02139

62

Harry R. Haige writes that he has started consulting and engineering services business in St. Petersburg and has contracts with Honeywell's Aerospace and Communication Center division. . . . **Richard J. Clayton,** who married Nancy Winslow of Littleton, Mass in 1965, writes that he spent from 1962 to 1965 doing research and working at R.L.E. at M.I.T., and obtained his M.S.E.E. at M.I.T. in 1964. He joined Digital Equipment Corp. in 1965 as biomedical applications engineer and project engineer, with present duties including Product Manager for PDP-12 laboratory computer line.

Henry McCarl writes that he will receive his Ph.D. this December from Penn State University in mineral economics and has accepted appointment full time as assistant professor of economics and lecturer in geology, College of General Studies, University of Alabama in Birmingham (1969-70 academic year). . . . The **Leland B. Jackson**'s report that the summer has been very big and eventful for them and now they are settled down to the surroundings of bewitched New Jersey farms. It reads this way: "Leland completed his Sc.D. thesis in E.E. at Stevens Institute of Technology and expected to defend it in September. He celebrated the completion with a trip to England and Greece in July." Immediately afterward, he and his family moved into their first house and started mowing, painting, plumbing, etc.—enter bewitched New Jersey farms. . . . **Michael S. Feld** brings us up to date with the reminder that he married Mary Haskell, has twin boys, age five, and is now assistant professor, Department of Physics, M.I.T. . . . **Steven J. Brams** is a visiting assistant professor of politics at New York University for 1969-70 and recipient of a National Science Foundation grant to study mathematical models in political science.

L. M. Evenchick is presently working for Planning Research Corp. of Westwood, Los Angeles, as Research Associate. He is assigned to a contract at the Jet Propulsion Lab at J.P.L., which is involved with the Mariner 69 and 71 projects. . . . **Paul V. Teplitz,** who received his D.B.A. from Harvard Business School, June 1969, S.B. in Electronic Engineering from M.I.T., an M.S. in E.E. from Carnegie-Mellon University, and an S.M. from the Sloan School of Management, is a member of the Analytical Studies Group, recently formed at M.I.T. as part of the Office of the Vice President, Organization Systems. The Group will provide staff support to the President, the Provost, the Academic Council and other groups at the Institute in the conduct of studies on issues of administrative policy and organization to improve their internal processes.

T. D. Scharton, has authored an article which evaluates three fixtures designed to stimulate impedance of a launch vehicle in research vibration tests of a half-scale model Nimbus spacecraft: "Development of Impedance Simulation Fixtures for Spacecraft Vibration Tests," Bolt Beranek and Newman Inc., Van Nuys, Calif.; it was written for N.A.S.A. . . . **T. P. Labuza** co-authored "The Surface Tension of Food Juices" in a recent issue of *Food Technology*. . . . Keep the good news coming, classmates!—**Gerald L. Katell,** Secretary, 310 Hoge Building, Seattle, Wash. 98104

63

From reading this column most of you must have the impression that your Class Secretary's dedication to his duties is at best minimal. So in my own defense I would like to tell you about some of the things I have been doing during the past year at the Institute. (Things other than writing this column.) It all started in the fall of 1968 in Pete Van Aken's living room when Woody Bowman asked me to contact Jim Champy, our fine class president to have someone substitute for Woody at the Alumni Association's Class Activities Committee Meeting. After several exchanges of you go, no, you go, I was selected. (If you wish to avoid getting involved it is not clear whether Pete's livingroom or Woody or both should be given a wide berth.)

The Class Activities Committee, whose Chairman is Don Hurter, '46, turned out to be a most interesting group which has been investigating activities available to Alumni. Among the accomplishments of the committee last year, were the planning and organization of the first workshop for class secretaries held in decades and a seminar for young alumni on how to start and operate a small business. The class secretaries workshop was headed by co-chairmen Howie Levingston, '51, and Linda Sprague, '60, and I was chairman of the young alumni seminar. . . . I was just formally (as opposed to the way it happened last time) elected to a three year term on the Class Activities Committee and am looking forward to this year's work.

Any of you having comments or ideas can use me as a pipeline or write directly to the committee. . . . On September 4, 5, and 6 the National Alumni Officers' Conference was held at the Institute. Attending from '63 were our President **Jim Champy** and your Secretary. I was personally able to congratulate Jim on his election to the M.I.T. Corporation This is an honor both for Jim and our Class.

New Businesses

At the time of our fifth reunion only two per cent of those replying to the questionnaire were in business for themselves. This however may be changing. There were 25 alumni from '63 attending the How to Start Your Own Business seminar held on campus October 4 and 5.

Gary Stone writes that he and **Tony Aponick** have founded Micronetics Inc., in Watertown, Mass. They are producing laser machine tools. . . . **Jim Champy** and Tom Garrity are involved in founding a consulting firm in Boston. . . . **Larry Beckreck** is a principal in a Cambridge civil engineering consulting firm. . . . **David Parker** has founded a firm for the placement of advanced degree personnel in Braintree, Mass. . . . **Tom Sikes** writes that he is founding a consulting firm in Los Angeles. Are there others out there?

From the Mail

John Brach writes that he and his wife Donna, living in Virginia, were expecting a child in September. He is with the consulting firm of Sverdrup & Parcel in Washington concerned with the design of subways. . . . **Allen Clark** and his wife Jeanne report that they are enjoying living in Atlanta with their child, a boy, now one year old. Allen is with the research department of the Coca-Cola Co. and has completed his Ph.D. in food science at Tech. . . . **Joseph Fielding** writes that he is a Major in the Canadian Air Force. . . . **Michael L. Finson** writes that he married the former Susan Goodwin. He is with Avco in Everett, Mass. . . . **William Jessiman** reports that he was a visiting lecturer in the Civil Engineering Department at Tech.

Tom Anderson is with the Boeing Company working on real-time computer aids to management. His hobbies include skiing, and sailing his Thunderbird. . . . **Kenneth Klein** is working on propulsion technology with the Gruman Corporation. . . . **Richard Merrill** reports that he created Focal for the PDP-8, 12, and 15. This program is now being used on some very large machines such as the CDC 6600. . . . **Lawrence Casey** is working on guidance systems at the Raytheon Company after completing his tour in the Army.—**Martin Schrage,** Secretary, 305 Massachusetts Ave., Arlington, Mass. 02174

64

If the class notes for this month seem more sparse than usual, the primary reason is that your Secretary has just moved from an apartment into a house in Memphis. Among the multitude of unpacked boxes, the news below was all

I could uncover. I might also note that as of November 1 my status changed from an associate in the law firm of Farris & Hancock to a partner in the firm of Farris, Hancock & Gilman. And now for the news: **Mark Alpert** is an assistant professor of marketing at the University of Texas. He has co-authored an article in the *Journal of Marketing* and two books in marketing management. . . . **Barry Blesser** has been promoted at M.I.T. from instructor to assistant professor and postdoctoral fellow in E.E. . . . **Ernest Cohen** states that there is nothing new in his activities. He reports that **Bill Eagleson** is working for Ford Motor Co. in Detroit, and that Bill and his wife Leatrice have a son named Philip.

Jeanne Fertel received her Ph.D. in physics at M.I.T. in September, and is currently pursuing job offers. . . . **John Graham** is currently a first year resident in psychiatric training at Jefferson Medical College in Philadelphia. . . . **Joe Kasper** is working at T.A.S.C. in Reading, Mass. Joe recently bought a house in Tewksbury, and his wife is expecting a child in January. . . . President Nixon has named **David Patterson** as a Foreign Service Officer of the United States. David will be assigned for an embassy or consulate soon. . . . **Barry Pearlstein** is working at Hughes in computer controlled radar systems and at the same time studying for his M.S. in mathematics at U.S.C. on a Hughes work-study fellowship. His wife Marlene gave birth to their daughter Jennifer Robin recently, making the total two girls and a boy.

Anthony Robinson has finished his internship at New York Medical College, and is now in psychiatric residency at Boston State Hospital. . . . **Robert Sanders** has joined the technical staff of Information Research Associates, Inc. as project engineer in charge of display terminal design for on-line data systems. He came to I.R.A. from Sylvania. . . . **Mark Schoenberg** is presently working in muscle electrophysiology at the University of Chicago in a postdoctoral capacity. Next year he will be a research associate at the National Institute of Health in a related field. . . . **Robert Scott,** currently assistant dean for administration in the School of Engineering at M.I.T., has been named to the Analytical Studies Group. The purpose of the group is to provide staff support to the president, the provost, and the academic council in the conduct of studies on issues of administrative policy. Bob will work in both capacities at the Institute.

John Timoshenko is close to finishing his course work on a Ph.D. in applied mechanics at the University of Connecticut. His wife Beverly had a daughter, Marina Agnes, in May. . . . **David Wolfson,** a lieutenant in the Air Force, has been assigned for duty at Charleston Air Force Station, Maine as a space systems operator officer for the Aerospace Defense Command. That's the news. Let me hear from you.—**Ron Gilman,** Secretary, 5209 Peg Lane, Memphis, Tenn. 38117

65

Currently the reunion committee is planning to schedule the reunion in Boston with Saturday devoted to various activities on the M.I.T. campus, including a set of informal luncheons and a banquet in the evening. Other events are being set up to provide entertainment and informal amusement for Friday evening and Sunday mid-day. Please answer the questionnaires and forward any suggestions to **Dick Schmalensee.**

Charles Gholz writes from Korea where he is in the Army Signal Corps and is in charge of the telephone exchange at I Corps headquarters near Uijongbu. He's doing just enough military justice work to remember what it was like to be a lawyer. . . . **Jim Young** was appointed to the committee on membership for the National Academy of Engineering. . . . **Ian Young** was promoted to assistant professor and postdoctoral fellow in M.I.T.'s electrical engineering department. . . . **Steve Maimon** is a senior engineer at Booz, Allen Applied Research in Bethesda, Md., working on problems in human engineering, oceanology, personnel training and manipulator devices. . . . **Allen Haberman** is continuing his Ph.D. work in molecular biology at Harvard University. . . . Captain **Thomas Perrone** is currently serving as Weather Officer at DaNang AFB in Viet Nam.

Jim Maskasky married the former Miss Elizabeth Hodges in 1966 and they report the birth of their first child, Hope Elizabeth, this past March. Jim received his M.S. in E.E. from Brooklyn Polytech and is now working at General Dynamic's Electric Boat Division. . . . **Alan Leslie** received his master's from Carnegie-Mellon and is now in his second year of Harvard's PH.D. program in statistical decision theory. Alan spent last summer traveling through Europe with Henry Surturio. . . . **Peter Klock** is at Johns Hopkins working on his Ph.D. thesis in X-ray crystallography. . . . **Chris Ebbe** is working on his Ph.D. in clinical psychology at the University of Missouri. . . . **Richard Bator** finished his M.S. from Northeastern last June and has formed Vision Systems, Inc., a computer graphics company located in Bedford, Mass. Richard is now the vice president in charge of proprietary development. . . . **Bill Park** is completing his dissertation on the control of multi-legged vehicles at the University of Pennsylvania.

George McKinney is now working in plant management at the Corning Glass Works after receivng his Ph.D. from Stanford's business school. . . . **Frank Mechura** is now the assistant to the vice president of Continental Can's Corrugated Container Division. Frank reports the birth of his second son, Jeffrey Wade, this past June. . . . **Po Mar** reports the arrival of a daughter, Pamela, in March. Po is currently the educational seminar's chairman of the New York M.I.T. Alumni Center.—**Jim Wolf,** Secretary, Birmingham Road, Gates Mills, Ohio 44040

66

In the latest packet of goodies I received from the Alumni Office, there was the usual quota of letters about our lack of columns over the last year or so. Some were nasty, some offered help, and most were just concerned. Without trying to differentiate among the categories, I merely list those who have at least shown enough interest in the Class to write: Michael Adler, Bill Marlow, Jon Meads, Lewis Gaines, Samuel Wagstaff, Jr., Michael Leavitt, and Bert Blewett. In addition to these, several others wrote about the missing columns but they also included some news in their letters so they aren't listed here. Two rather humorous ones must be singled out for recognition, however, since they are quite coincidental. **Ralph Schmitt** wrote from California asking, "Is our Class Secretary hiding in Argentina?" And **Stanley Feder** replied from Boston (supposedly unaware of Ralph's letter!?), "The Class of '66 is alive and well in Argentina." Ralph also writes that he has dropped to a 20 hour work week in the space business in order to attend the University of California at Irvine to get an M.S. in statistical communications.

Now for a few quickies: **Claude Cassady** received an M.A. in biophysics from Harvard and then enlisted in the army in April, 1968. . . . **Stuart Madnick** started work towards his Ph.D. in electrical engineering in September after receiving his S.M. in management and an E.E. in June. . . . **Gordon Olson** is working in the Aerodynamics Department of McDonnell Douglas Astronautics Company in St. Louis. . . . **Enrico Poggio** is going for his Ph.D. in physics at Tech, and **Howard A. Smith** is studying astrophysics at Berkeley. . . . **Robert Kittredge** took a two year leave of absence from M.I.T. to satisfy Uncle Sam. He returned to graduate along with the Class of '69 and married the former Louise Lowe in December 1968. . . . **Dick Leslie** is a chemical engineer doing process development work with halogenated organics. He passes the time by skiing and sailing his 19-foot Lightning class sailboat.

Norman Brockmeier who received a Ph.D. in chemistry with us spent the month of August consulting in San Francisco with Chevron Research. He visited with Don Chase of our Class, Gerald Nacamuli '67, Alex Bell '67, and Bob Merrill '65, chemical engineers all. Norman's wife and two daughters accompanied him on his trip.

Richard Wolf is at Lockheed-California as a marketing engineer, trying to show that the L-1011 is better than the DC-10. He is developing computer programs, and somehow (incredibly) "the work makes me long for the days of 5.01." Maybe it was his handwriting!?

After spending three years in Temuco, Chile, as an architect/city planner for the Chilean Ministry of Housing and the

Peace Corps, **Richard Leonard** has returned to school. While his newly acquired (August) wife Margy (formerly Margaret C. Schiring, Wellesley '68) works, Richard studies for a master's in city planning at the University of Pennsylvania. . . . A film, *But What Can We Do?*, shown at the M.I.T. research stoppage on 4 March, 1969, was the product of **Leonard Henny,** S.M.'66, City Planning. The documentary film pictures the dilemma of a defense engineer who opposes the war in Vietnam.

Each month I read a number of the other Alumni columns for news in the hopes of reading about someone I know. I have noticed that several class secretaries nominate as the Hero of the Month that person who has contributed most to the monthly column by way of news of other classmates. This seems to me to be a fruitful idea since it perhaps will stimulate those of you who run into others in the Class to let me know about them as well as yourself. Therefore, each month I, too, will nominate a Hero of the Month who best fulfills the above conditions. If nobody writes enough, then I may have to nominate someone on other grounds, or select at a Boob of the Month, or perhaps both. By the way, the Hero of the Month receives no money, plaque inscription, or trophy—only the fleeting satisfaction of being King of Class Communication.

Now without further adieu, I present the first Hero of the Month: **Jerrold Abraham.** On 25 July 1969, he and his wife Harriet became parents of a daughter, Melissa Ellen. To **Gene Sherman** he says hi! He reports that **Dan** and June **Allen** have a son Edmund, born last spring, and are living in La Jolla, Calif., also that **Tim Carney** is in the United States Embassy in Maseru, Lesotho, after two years in Saigon. Thank you and congratulations, Jerrold. May you wear your invisible crown of glory with pride! . . . Probably my favorite pleasure of the day (well, almost) is to gather my morning post, which arrives at 7:30, and read it over breakfast. That pleasure is greatest when I get a letter in it along with all the magazines and junk mail. By sending in your comments about the class notes and news about yourself and others directly to me, you will render the Class a service, start my day off right, and maybe even win the Hero of the Month Award. Besides, your letter gets in the notes quicker. Cheers!—**Terry J. Vander Werff,** 24 Horwood Close, Oxford, England OX3-7RF

68

I've been noticing that Mike only lets me write the column in the leaner months (in terms of news clippings, at least). So please keep sending more stuff—it makes life easier for me. I'm further handicapped this month by aching muscles, even in my fingers, since we just returned from an expedition up Mt. Monadnock in New Hampshire. The most physical exercise I'm used to is pushing an elevator button. But, the column must go out. . . . Only one wedding to report this time. **Gerald Sussman** married Julie Mazel, '70, this past summer. Both are students working at Project Mac.

Dick Turner writes that he completed his M.S. in aerospace engineering at the University of Michigan in April, after which the Air Force sent him to the 54th Aerospace Recon. Tech. Wing (SAC) at Offutt A.F.B., Omaha, Neb. He works as an engineer in the 544th's Trajectory Center, aiming the S.A.C. I.C.B.M. force. He says that at present his job consists mainly of computer work and is not too demanding. Indeed, he writes that "the job could be done by any well-motivated product of Project 100,000" but he hopes the work will become more interesting. Since he's been there he had a week T.D.Y. at Vanderberg A.F.B., Calif. In his free time, he's been playing golf and doing some running for exercise. He shares an office with Captain Joe Pustis '61, who also got an M.S. in aerospace engineering at Michigan. Dick writes that **Dan Gruger** is out of the army and is doing computer work for Merck, Inc.

More news of a military nature: **Irwin Simon** has acquired the title Lieutenant. No further details are available. . . .**Dave Ellis** was drafted last January, but received a postponement, allowing him to attend six "glorious" weeks of summer camp at Ft. Benning, Ga. and enroll in the last year of army R.O.T.C. at Harvard. This will enable him to get his law degree in June 1971. . . . Lieutenant **Francis Gibbons** entered the navy's nuclear powered submarine program after graduating from M.I.T. After two years of school, he was assigned to the U.S.S. *Lewis and Clark* SSBN-64 as assistant weapons officer. He and his wife Carlene are presently living in Charleston, S.C. with their 18-month-old son, Scott.

Ellen Greenberg is back in Cambridge after spending a year at the University of Chicago, and is living with **Ginny Fano** who is back from Wisconsin. . . . **Paul Durda** has also returned to the Boston area after spending a year as an associate biochemist for Eli Lilly and Co. in Indianapolis, Ind. He is happily married to the former Mary E. Brehm, MGH '67, and is working on a Ph.D. in biochemistry at Tufts' Medical School. This area seems to have an unholy attraction, I'm beginning to believe. Once you've been here, you're never quite sure when you leave that it's for good. Must be something in the air—pollution, maybe?

Don Batchelor has transferred to the Reston, Va., facility of New Hampshire based Sanders Associates, Inc. in order to believe. Once you've been here, you're to enter graduate school at University of Maryland. He is now a part-time student working toward an advanced degree in physics. . . . **Wendell Scarlett** is now studying physics at University of Minnesota. . . . We have heard from several people attending school in sunny California. **Dan Harris** is at Caltech, and is now president of the Flying Club there. As he puts it, he is busy "further polluting the air of southern California." . . . **Sue Downs** is in the doctoral program in engineering economic systems at Stanford (after getting a B.S. and M.S. in Course VI in September 1968). Actually, at present she is in Washington, D.C., because part of her program involves working for a year (until September 1970). She is in the Systems Analysis Group in the Office of the Secretary of Transportation working on an economic analysis of an express bus system and is also looking at transportation demand modeling.

Finally, **Jim Lewis** and **Paul Kimball** are both at Berkeley. Jim is working in the Department of Biochemistry, and Paul is with the Department of Molecular Biology.

My own news this month is that I have passed my doctoral qualifiers in nuclear engineering, so "all" I have to do now is my thesis. I will be working in the field of radiation damage on materials.—**Gail** and **Mike Marcus,** Secretaries, 60 Wadsworth St., Apt. 16A, Cambridge, Mass. 02142

69

I have received information from only a few of our classmates thus far. Please drop me a card letting me know where you are, what you are doing, to whom you are married, etc., or else this column will be printed in red and grey.

As for the news I do have, **Jim Gallagher** is technical chairman for the Boston area chapter of the Institute of Environmental Sciences. . . . **Barry D. Milder** is enrolled in the first-year class at the Washington University School of Medicine in St. Louis.

Steven H. Rothman has joined Digital Equipment Corporation of Maynard, Mass., as a logic design engineer. . . . **John J. Blankinship, Jr.,** is married to the former Emily J. Canning, and is working on his master's degree at the Polytechnical Institute of Brooklyn while employed as an aeronautical engineer by the Grumman Corporation. . . . **William Caffery** is employed by the M.I.T. Instrumentation Labs.

The former Miss **Dinah Schiffer** is married to Al Singer, '68, and is a graduate student at Columbia University. . . . **Denis A. Bovin** is enrolled in the first-year class at Harvard Business School. . . . **Franklin Preston Rogers** is employed by the Excelsior Foundry of Belleville, Ill., and is attending evening classes at the Washington University School of Business Administration in St. Louis. . . . **Richard Parker** is working towards a Ph.D. in economics at Boston College. His current research interests include the application of large econometric models to a wide range of public policy decisions.—**Richard J. Moen,** Secretary 312 Shaw Hall, Cambridge, Mass. 02139

The Gregorians, father and son. Two generations of a family renowned for its acquisition of great Oriental rugs.

Persia is in their blood. Three times each year the Gregorians return to the homeland. To the hamlets and bazaars they know so intimately. To Iran, Turkey, Afghanistan. To the provincial towns where these exquisite, rare rugs are created.

For that's the secret of a "great buy". The source. The Gregorians do it themselves, the hard way. They seek out, and hand-select, every rug. They have that indigenous knack for finding the finest Kirmans, Kazaks, Shirvans, Boukaras, Afghans, Bidjars — and hundreds of other rug varieties. More than 3,000 rugs. One of the largest single stocks in the Western World.

All at Newton Lower Falls, Massachusetts. It's a trip to Persia. With rugs generously loaned on approval.

Send for new catalog of current rugs and prices. And dig into Mr. Gregorian's newly reprinted book "Oriental Rugs and the Stories They Tell". Sixty-two color plates. Crisply written. Just $14.50, postpaid.

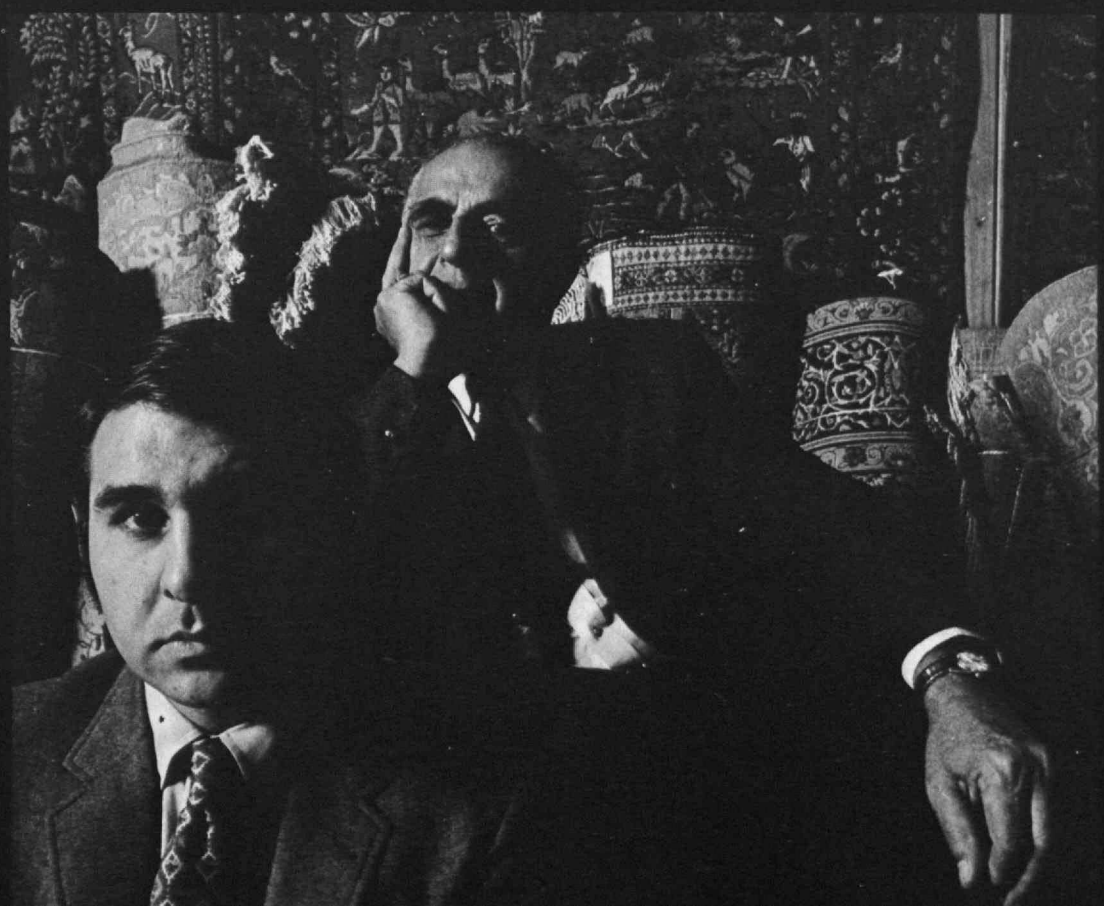
Phone us collect on all inquiries. It's like a direct line to Persia. Or write:

Arthur T. Gregorian inc.

2284 Washington Street, Newton Lower Falls, Massachusetts 02162
(617) 244-2553

You judge a man by his fibre.

Before you look at the fibre in a rug, look at the fibre in the men.



Help exterminate the QUADRADECAPEDE!

West Concord, Mass. - Doctors here announced a cure for the virus streptocircuitus integratus, transmitted by the fourteen-legged logic bug and prime cause of inflamed logic and many chronic output diseases.

A statement released by the group said in part, "By using the new General Radio 1790 Logic-Circuit Analyzer, with all its active ingredients, we are now in a position to perform 100% functional testing – on even the most complex modules. The computer-controlled 1790 can test devices with as many as 96 inputs and 144 outputs, checking from a simple functional GO/NO-GO test to a detailed step-by-step analysis for the debugging of defective units, and the optional programmable logic levels permit marginal testing!

"For only $32,500 we can't see why any user of printed-circuit boards or integrated arrays would be without one – especially since extensive programming knowledge isn't required. The results have been overwhelming! In several thousand test cases we've been able to eliminate defective IC's and modules early in the game, thereby producing harmony, well-being, and great cost savings in production."

Help increase the yield and longevity of logic circuits! Write or phone for more information from General Radio Company, West Concord, Massachusetts 01781; telephone (617) 369-4400. In Europe write Postfach 124, CH 8034 Zurich 34, Switzerland. Price applies in U.S.A.

GENERAL RADIO